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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson N. Y.

*GEODETIC OPERATIONS IN THE UNITED STATES.**

THE geodetic operations in the United States, as executed by the Coast and Geodetic Survey, may be grouped into three distinct periods of time. The work was authorized by Congress in 1807, but a quarter of a century elapsed before anything was done in the field worthy of the name of Geodesy. This closed the first period, which may be characterized as the era of preparation and education of public sentiment. In 1832 operations were begun with vigor, and the foundation was laid for a great national work. The Survey was conducted on the same general lines of policy for eleven years, when the reorganization of 1843 established its permanent status. No great deviation has since been made from this plan, which has now held for fifty-five years. If we eliminate the Civil War period of five years, during which work was suspended, and regard operations before the reorganization as of a preliminary nature, we have half a century of geodesy. During its comparatively short existence the Survey has been three times under the control of the Treasury Department, twice under the Navy, and once under law requiring its personnel to be army or navy officers. The direction of the work has, however, remained throughout

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in the hands of a civilian, and civilian methods have been applied in the administration. At the present time it has been continuously under the Treasury for a period of sixty-two years. Although statistics do not always give an adequate conception of the work to which they are supposed to bear testimony, a general idea of the activity displayed may be had from the following statement of work done:

350,000 square miles (906,500 sq. kilo.) of triangulation, embracing
15,000 stations for horizontal measures, and determining
28,500 geographical positions at which
1,000 astronomical coordinates have been observed.

38,500 square miles (99,710 sq. kilo.) of topography, embracing
11,600 miles (18,670 kilometers) of general coast line and more than
100,000 miles (160,900 kilometers) of shore line (rivers, etc.), also including
51,000 miles (82,080 kilometers) of roadways.

545,000 miles (877,100 kilometers) of sounding, covering
164,000 square miles (424,800 sq. kilo) of area, besides
93,000 miles (149,700 kilometers) of deep sea sounding, in which
14,000 bottom specimens were obtained.

4,600 original topographic and hydrographic sheets, from which
1,300,000 charts have been made and distributed;
30,000 original volumes of observations, including magnetic records from
1,100 stations.

BASE LINES.

Two hundred and three base lines have been measured, of which nineteen, on account of their accuracy, length and geodetic connection, are classed as primary. The average length of these is 9,892 meters. The probable error, which includes both that of measurement and the comparison with the standard, is 22.2 millimeters, or about 1/445,000 of the length stated. Speaking of the three types of apparatus used in the Survey, and referring now to errors of measurement purely, it may be said that with the different forms of metallic bars, compensating and otherwise, the error is one-millionth part of the length measured. With the tape line the accuracy may be increased to 1/2,000,000, while with a rod in melting ice 1/5,000,000 is easily attainable. In the first form the contacts are material; in the last, optical; with the tape they are linear. The cost is greatest for the rod in melting ice, and least with metallic bars.

Attention may here be called to a new form of base apparatus named the Duplex and designed by Assistant William Eimbeck. It consists of two bars, brass and steel, five meters in length, so arranged that the measure may be made with each component separately and simultaneously. It may also be employed as a Borda scale, or the temperature may be directly observed. Some unique features, which need not here be described, are employed in its manipulation. The Salt Lake base, measured in 1896, gave results with either component having a probable error of less than 1/5,000,000 part of the measured length.

TRIANGULATION AND ARCS.

The shore line of the United States, exclusive of Alaska, is 5,452 miles (8,774 kilometers). This has been covered by triangulation, with the exception of a few hundred miles on the northwest coast. An oblique arc of 22° has been measured from the northeast boundary in Maine, to the southwest limit of Alabama, on the Gulf of Mexico, and an arc of 49° on the 39th parallel of latitude has been completed, from the Atlantic to the Pacific. All of the New England States, a large part of the Middle ones, and considerable areas in the South and West, have been covered with triangulation. Adjacent regions have had careful reconnaissance. The work in this direction has been executed on a large and accurate

scale. The greatest triangle has sides of 133, 167 and 190 miles (214,269, and 306 kilometers). The highest station is over 14,000 feet (4,267 meters). Operations of such magnitude justify the introduction of refinements not usually employed. The latitudes are corrected for elevation, and the horizontal directions are changed, to reduce them to the sea level of the observed station. A distinctive feature in the final adjustment is the application of weights depending on both the station errors and those arising from the closing of figures. These are treated separately, but the final weights consist of two parts, one resulting from local conditions and varying with each direction, and the other deduced from the formation of triangles and remaining constant for the network under consideration In the California work the probable error of a direction at any station was 0″.081 while that from the closing of triangles was about twice as much. The latter necessarily includes the former. The two are separated by means of the formula

$$e_c = \sqrt{e_t^2 - e_s^2}$$

which gives the resulting combination error as ± 0″.169. e_t is the probable error of a direction from the closing of triangles, and e_s is the average probable error of an observed direction from station adjustment. Each direction, therefore, enters the final adjustment with a weight derived from measures at its own station, added to the above value, which represents the constant part for the entire figure. The cost of the transcontinental arc from Cape May to San Francisco was two hundred dollars per linear mile ($124 per kilometer), three and a half dollars per square mile ($1.35 per sq. kilo.), and two thousand dollars per station.

A fine example of rapid expansion from the base to a fully developed net of triangulation is found in the vicinity of Salt Lake, and is a characteristic specimen of primary work as carried out in the Rocky Mountain region of the United States. The average height of the thirteen stations composing the main scheme is 11,256 feet (3,431 meters), while the average length of the lines connecting them is 159,734 kilometers (99¼ miles). The distance between Mt. Ellen and Uncompagre is 294,104 kilometers (182¾ miles). This remains to the present day the longest line observed from both ends and forming an integral part of a regular system of triangulation executed by any trigonometric survey in existence. Indeed, the entire chain from the Sierra Nevada on the west to the Mississippi plateau on the east is without a parallel in similar work, when we consider the magnitude of the geometrical figures, the elevation of the stations and the refinement of the individual measures.

Referring to a part of this work—the base net at Salt Lake, Utah—the following details are of interest:

The elevation of the base above sea level is about 4,224 feet, while the mean height of the stations composing the quadrilateral is 11,088 feet. In only five steps we pass from a base 11.2 kilometers in length to a line 237,765 kilometers long (Pilot Peak, Mt. Nebo). This involves an average multiplication of 4¼ times for each step of expansion, which is within the limit set for development in well conditioned triangulation. The resulting quadrilateral in which the base line expansion culminates and on which the transcontinental extension rests contains nearly 10,500 square miles and is the largest yet realized. The base net including this figure (Ogden, Mt. Nebo, Ibepah and Pilot) was adjusted separately and brought out the following criteria of accuracy:

FROM STATION ADJUSTMENT.

Average probable error of a single observation of a direction	= 0″.71
Average probable error of an adjusted direction	= 0 .10

FROM FIGURE ADJUSTMENT.

The largest correction is.....0″.84
And 55 per cent. of the corrections are less than..0 .25

The probable error of the side Ibepah-Nebo, depending on angular measures only, is 1/280,000 of its length.

Heliotropes were continually employed, and the angles were measured with a theodolite having a horizontal circle of 20″ diameter and a magnifying power of 83.

ASTRONOMICAL WORK.

Aside from the work in practical astronomy incident and necessary to the operations of every trigonometrical survey, attention has been given to various other phases of the subject. It has not alone sufficed to point out and demonstrate the utility of the method of equal zenith distances for latitude, and of the application of the telegraph to longitudes. The Coast and Geodetic Survey feeling the necessity of better star places, arising from the use of the methods just mentioned, has devoted some of its energy to the perfection of star catalogues. It is probably no exageration to say that the declinations given in our field lists are the best attainable anywhere. More than fifty of the best modern catalogues are corrected for their systematic errors, and each is given weight depending on the value of the work and number of observations. A collection of all these data, and their consolidation into one homogeneous result, eliminates as far as possible all known sources of inaccuracy, and gives us finally the most reliable positions. A list so constructed of several thousand stars has been already published, many of which are especially adapted to southern work. The average probable error of a declination may be given as rather less than $\frac{1}{4}$ of a second; a degree of precision, which enables an observer to determine his latitude from 20 pairs, in one evening, with an uncertainty of only $\pm$ 10 feet. This is sufficient for the purposes of geodesy. Incidental to regular astronomic work, the Survey has equipped and sent out no less than 35 parties for the observation of solar eclipses and transits of the inferior planets, which work has required the occupation of stations in every continent and Polynesia. The variations of latitude have been determined at three stations, each one having been occupied more than a year.

MISCELLANEOUS OPERATIONS.

The legitimate field of investigation in a geodetic service embraces many subjects outside of those already specified. In the execution of the task before us a free interpretation has been given to the law authorizing the work, and the kindred subjects of Hypsometry, Magnetism, Gravity and Physical Hydrography have been pursued along with others more strictly within our province.

Five thousand miles (8,047 kilometers) of precise levelling have been executed, including four independent determinations of the height of St. Louis. Two have been made from the Atlantic at Sandy Hook, and two from the Gulf of Mexico at Biloxi.

A comparison indicates that the surface of the Gulf is somewhat higher than the sea level at New York, and this has been verified in character, although not precisely in amount, by a line across the peninsula of Florida, three times repeated. Other subsidiary lines have been observed. The limit of error has been that usually adopted in similar work, viz., 5 mm. $\sqrt{K}$. The heights by spirit level have been supplemented and controlled by micrometric measurements of zenith distances. In the determination of elevations necessary to reduce the base lines along the transcontinental arc to sea level the latter method has been employed across the Allegheny and Rocky Mountains. The spirit levels are continuous from Sandy Hook to Denver and Colorado Springs.

They are checked by zenith distances from the Chesapeake Bay to the Ohio River, and supplemented by the same method from Denver to the Pacific coast, where the spirit levels are not yet completed.

Permanent magnetic observations have been in operation at Philadelphia, Key West, Madison, Los Angeles, and each one has furnished records for five consecutive years; with one exception a self-registering apparatus has been continuously and exclusively employed in each locality. These data added to records from 1,100 widely distant points, many of which are secular variation stations, furnish precious material for the study of the earth's magnetism. The work of the Survey in the investigation of the force of gravity has been carried on both within and without the limits of the United States. Twenty-eight foreign stations have been occupied, including points in Europe, Asia, Africa, Australia and many islands in both the Atlantic and Pacific. New light on the subject of volcanic formation, as well as on the constitution of the earth's crust, has come from this work. Fifty nine-stations have been observed at home, including a line across the continent. Half-second pendulums are now exclusively employed, and the determinations are purely differential. The period of oscillation is usually known to within a few millionths of a second.

In the field of Physical Hydrography most comprehensive studies have been made.

The exploration of the Gulf Stream, including a study of its density, temperature and currents, the geology of the sea bottom, the establishment of cotidal lines, the determination of the ocean depth from earthquake waves and other specialties in the domain of hydrography, have been made a part of the regular work. The hydrography of the coast, to the head of tide-water, has been developed side by side with the triangulation and topography.

The practical results of the Survey are shown in the publication of the annual reports, the issue of charts, notice to mariners (corrected monthly), coast pilots for Atlantic, Pacific and Alaskan waters, tide tables (now extended to foreign ports) and various miscellaneous publications in special lines of research.

PRESENT AND FUTURE OPERATIONS.

A resurvey of Chesapeake Bay, the measurement of an arc through the United States on the 98th meridian, and the development of Alaskan geography, are among the projects of Dr. Pritchett, the present superintendent of the organization. All these have been carried on during the last two years. The line of transcontinental precise levels is being pushed westward with all available means. Primary triangulation on the Pacific coast has been resumed, and will soon be completed from San Francisco to the Mexican boundary. Hydrographic surveys are in progress along the Atlantic seaboard, on the Pacific, and at the mouth of the Yukon in Alaska. Numerous topographic, astronomic and magnetic parties, are employed in the interior.

An extension of the great arcs of the United States into Mexico and the British possessions has been proposed by Dr. Pritchett, and diplomatic representations between the interested governments looking towards concerted action in the near future have already been made. This will give to North America an additional meridian arc of about 55° and an oblique one of 33°. Together with existing arcs, the proposed material will practically exhaust our contribution to the determination of the earth's figure.

In the ordinary prosecution of the field work since 1895 about fifty parties have been employed during the course of each

year. Added to this, the purely hydrographic work has been carried on by a fleet of sixteen vessels, of which ten are steamers. The operations have been widely distributed, extending as far as the Pribilof Islands in the Bering Sea. A longitude determination was made from Sitka, of Kadiak and Unalaska, in which twenty-one chronometers were carried on four successive trips. The probable error of the resulting longitudes was 0ˢ.20 for the former and 0ˢ.21 for the latter. A tidal indicator, similar to the one in New York, has been erected at Philadelphia, and one is in process of construction at San Francisco. The mechanism, actuated by the tide, furnishes the navigator at any moment, at a distance of one mile, with necessary information as to the character and amount of the tide.

Among the auxiliary duties of the service may be mentioned the establishment of trial speed courses for ships of the Navy (a number of which have been recently laid out); the exploration of oyster beds; the fauna of the Gulf Stream; the administration of an Office of Standard Weights and Measures, from which prototypes are issued to the different States; meteorological researches for the use of the coast pilot; the study of astronomical refraction; mathematical investigations on the theory of projections, on the equations of steady motion, on errors of observations; and finally, in experimental researches in engraving, electrotyping and lithography; all of which knowledge finds application in the various fields of activity now covered by the Coast and Geodetic Survey.

WORK OF THE UNITED STATES ENGINEERS.

Geodetic surveys have also been carried on by the Corps of Engineers of the United States Army. That of the Great Lakes was completed in 1882. The work was reorganized in 1892, and resurveys and extensions thereto are now in progress. Changes in the original plan have been introduced, chiefly in the direction of rapidity of execution. Fewer positions on the circle are now used for horizontal angles, and adjustment is effected by separate small figures, rather than through any extended scheme. In the measure of the Mackinaw base three tapes were used, each a kilometer in length. Each section of the tape was compared with a standard length of 100 meters established on the ground. This standard length was determined by means of an 8-meter bar packed in ice, which in turn was compared with the Repsold meter, R 1878.

The Engineer Corps of the Army has also had charge of the Mexican boundary survey, and of the work done by the Missouri and Mississippi River Commissions. The report on the Mexican boundary is already in type, but is not ready for distribution.

The Missouri River Commission has completed a triangulation from St. Louis to Three Forks, in Montana, a distance of 2,551 miles. The work follows the river and covers the valley from bluff to bluff. Precise levels have been run over 807 miles of it, and ordinary levels cover the remainder. Ten base lines have been measured with a standardized steel tape.

The Mississippi River Commission, utilizing some work already done by the Lake Survey and the Coast and Geodetic Survey, has now a complete connection from the Gulf of Mexico to St. Paul, in Minnesota. The total distance is about 1,600 miles. Twenty-seven bases have been used, of which eighteen have been measured by the Commission with a steel tape 300 feet long. The work has been adjusted by quadrilaterals employing the method of least squares.

E. D. Preston.

Executive Officer to Superintendent
U. S. Coast and Geodetic Survey.

THE AMERICAN MORPHOLOGICAL SOCIETY.

I.

THE ninth meeting of the Society was held at Columbia University, New York City, on December 28th, 29th and 30th. Professor H. F. Osborn was in the chair; Dr. G. H. Parker, Secretary. In the course of his introductory remarks, Professor Osborn welcomed the Morphologists to the new zoological laboratories at Columbia, and especially congratulated the Society upon the rapid progress which morphology in all its branches is making in this country. He spoke of the important part which had been played by the *Journal of Morphology* during the past eleven years, and the debt owed by American zoologists to Mr. Allis for his generous support. This journal now requires for its maintenance the financial support of all morphologists of this country, all of whom should assist by subscribing. One of the marked features of recent progress is the rapid development of fresh-water and marine biological stations, all of which are contributing to our detailed knowledge of American fauna, and in some cases extending even to the study of important foreign types. The greatest defect in recent work is the tendency to prolixity. 'Brevity is the soul of wit,' and the very expansion of zoological literature necessitates as condensed a style of writing as is consistent with completeness and clearness. The recently collected papers of Huxley prove that it is possible to present the most important results in very condensed form.

In the business session the following are the more important transactions: A resolution expressing the grateful acknowledgments of the Society to Mr. Edward Phelps Allis, Jr., for his munificent gifts towards the founding and maintenance of the *Journal of Morphology* during the first ten years of its existence; the election to membership of F. W. Bancroft, C. L. Bristol, G. N. Calkins, J. J. Hamaker, Samuel Henshaw, C. F. W. McClure, C. B. Wilson and M. A. Wilcox; and the election of officers: President, E. G. Conklin; Vice-President, W. M. Wheeler; Secretary and Treasurer, Bashford Dean; Executive Committee, J. P. McMurrich and G. H. Parker.

Forty-five papers were presented before the scientific sessions, of which the greater number are here given in summary in the order in which they were read.

Notes on the Development of a Myxinoid. BASHFORD DEAN.

PARTICULAR reference was made to the horn-like egg membrane as maternal in origin; it is traversed by pore-canals analogous to those of the radiata of teleostomes. The anchor filaments represent the greatly specialized end-bulbs of the radial elements of the shell. Early segmentation is confined to a small but definite hillock of germinal protoplasm subjacent to the micropylar canal. In early blastula stages the cell cap extends downward to the region of the opercular ring. Gastrulation is noted when a downgrowth takes place on one side; here the head of the embryo shortly appears, and the trunk is laid down longitudinally as the blastoderm progresses, now symmetrically, toward the vegetative pole. Neural folds are early apparent, and the brain is tubular and relatively of great length. In some cases the tail buds out when the downgrowth of the blastoderm has enveloped scarcely more than the anterior half of the egg. In others the outgrowth of the tail is notably retarded. A primitive streak is present, terminating behind in an ovate yolk plug; the latter is latest apparent near the vegetative pole. There is no evidence of a greater number of gill slits than the normal number.

On the Reproductive Habits and Development of the Californian Land Salamander, Autodax. W. E. RITTER. (Presented by G. H. Parker.)

The subterranean egg-burrow of this saltatory urodeles resembles somewhat closely that of *Ichthyophis*. The eggs are retained in a cluster and attended and kept moistened, probably with urine, by the female. A series of embryos taken from a single burrow will shortly be described.

New Facts regarding the Development of the Olfactory Nerve. W. A. Locy.

The early embryonic history of the olfactory nerve is known. There has been little advance in this direction since the appearance of Marshall's paper in 1878, who gave the history of the nerve prior to the formation of the lobe and anticipated by suggestion most of the views since expressed regarding its nature and relationships. The chief advances have been made in determining the source of the fibers (His, Disse and others), and in the minute structure of the olfactory lobe, ganglion, etc. (Cajal, Retzius and others). But, in the meantime, the early embryonic history has not been elucidated, and, even to-day, we do not possess the complete history of this nerve in any one animal.

This paper presented in outline the history of the olfactory nerve in *Acanthias* from its earliest appearance to adult conditions, embracing (*a*) the embryonic history of the olfactory nerve prior to the formation of the lobe, and (*b*) the formation of the olfactory lobe, its various transformations, and the subsequent history of the nerve. The chief point of interest consists in demonstrating a hitherto unrecognized olfactory nerve, and determining its history and relationships to the olfactory bundle. The new nerve arises from the summit of the forebrain near the median plane, and passes laterally into communication with the main olfactory and thence into the olfactory cup. It is the first one to appear and may, therefore, be primitive. It is ganglionated. It was discovered by dissections of very small embryos—it lies in such a position that its relationships would not be appreciated by study of sections made in any of the conventional planes.

There are two distinct, widely separated connections existing simultaneously between the olfactory epithelium and the brain-wall, one is dorsal and median (the new nerve) and the other is lateral. The latter is complex, consisting of two main divisions. The new nerve can be demonstrated in specimens, as early as 6–8 mm. in length. The two brain connections are well seen in embryos 16 mm. and upwards; they are very evident from 20mm. forwards. The lobe begins in specimens about 25mm. long; it is still small at 38mm., but well developed at 44 mm. and upwards. The fibers of the new nerve were traced into the olfactory epithelium. It was also shown to perish in the adult.

Review of Recent Evidence on the Segmentation of the Primitive Vertebrate Brain. W. A. Locy. (Read by title.)

The Metameric Value of the Sensory Components of the Cranial Nerves. C. Judson Herrick.

The primary segmental or branchiomeric nerve is conceived as comprising four components: somatic motor, viscero-motor, somatic sensory (general cutaneous) and viscero-sensory (communis). No cranial nerve of any gnathostome vertebrate has retained all these components.

In the head each sensory component, as a physiological adaptation, has been concentrated so that all its fibers tend to be related to a single center in the brain—the fasciculus communis (f. solitarius) and chief vagus nucleus in the case of the visceral sensory and the spinal fifth tract and related nuclei, chief sensory trigeminal n. and n. funiculi, in the case of the somatic sensory. This involves reduction of each component in some segments and hyper-

trophy in others. Thus, the somatic sensory is represented only in the V and X nerves and the visceral sensory in the typical branchiomeric nerves, X, IX, VII.

Now when in course of vertebrate evolution specialized sense organs appear in addition to the two primary components, their nerves and intra-cranial centers will appear sporadically, depending upon the distribution of the specialized sense organs in question. These nerves will in general follow the courses of the previously existing somatic or visceral nerve trunks wherever possible, hence the formation of complex nerve trunks containing several of the components. Each of these cenogenetic systems of sense organs, like the palingenetic systems, tends to be related to a single intracranial center. At present we may enumerate the following such systems:

1. Taste buds related to the fasciculus communis (f. solitarius) and its associated nuclei, the chief vagus nucleus (lobus vagi of fishes).

2. Terminal buds of the outer skin; terminal relations as in the last case, plus in some fishes the lobus facialis.

3. Lateral line organs, or neuromasts, related to the tuberculum acusticum and cerebellum, plus in some fishes the 'lobus lineæ lateralis.'

4. Ear; central connection as in the last case.

5. Eye; related to the mesencephalon.

6. Nose; related to the primary prosencephalon.

7. Pineal organ; related to the diencephalon?

Diagrams were exhibited illustrating the actual relations of these components as determined by reconstruction from serial sections in the bony fish, *Menidia;* and emphasis was laid upon the necessity of taking these qualitative differences in the nerves into account before trying to work out their metamerism.

The Maxillary and Mandibular Breathing Valves of Teleost Fishes. ULRIC DAHLGREN.

THE discovery of a pair of membranous valves placed just inside of the teeth and working automatically to prevent water from leaving by the mouth while they permit its free entrance, has enabled the act of breathing in fishes to be clearly described. These valves complete the pump-like structure of the oral cavity, the other pair, or posterior valves, being the branchiostegal membranes.

In breathing, but two muscular forces must be applied, one to expand the oral cavity by moving the opercular frames outward and another to contract the oral cavity by moving them inward; when expanding, water comes in through the mouth, being prevented from entering through the gill clefts by the branchiostegal membranes, which act *automatically* and independently of and contrary to the opercular frames to which they are attached; when contracting, water is forced out of the gill clefts, but is prevented from leaving through the mouth by the valves in question, which act *automatically.* While breathing, it is true, the fish opens and shuts its mouth somewhat, but this is due not to its effort to prevent a regurgitation of the respiratory stream, but to the relation of its mandible to the opercular frames.

When the valves are cut, the fish is compelled to use muscular force to prevent regurgitation.

On the Early Development of the Catfish (Noturus). F. B. SUMNER.

1. No horizontal cleavage takes place till the 64-cell stage or after, and, when it occurs, does not result in a definite two-layered condition of whole germ-disc.

2. The blastomeres resulting from the early cleavages retain their continuity with the protoplasmic network of the yolk. No sharp line of separation, such as Sobotta,

Behrens and Samassa describe for the Salmonidæ, exists in the egg of the catfish.

3. After horizontal cleavage occurs, the lower cells resulting from this division retain their continuity with the yolk, as has been described by Kowalewski, Hoffman and Berent (Teleosts) and Dean (Ganoids). These partial cells (merocytes) continue to divide by mitosis both horizontally and vertically. In the former case, the upper of the products of division is added to the germ-disc. This process of supplementary cleavage continues until a late segmentation stage, cells being added to the whole lower surface of the germ-disc.

4. The periblast arises from the residual portion of the merocytes after supplementary cleavage has ceased, being thicker under the margin of the germ-disc, but present elsewhere from the beginning.

5. The periblast is trophic in its function, playing only an indirect part in cell-formation. Normal mitosis soon gives place to abnormal and this in turn to amitosis. Transitional forms occur.

6. The subgerminal space (segmentation cavity) does not appear till about time of origin of germ-ring. At close of segmentation, yolk and blastodisc are in close contact in well-preserved specimens, although no longer continuous with one another. Clefts which early appear between blastomeres or below them are probably artifacts. If not, they disappear later.

7. The germ-ring (mesentoderm) arises primarily as a marginal ingrowth due to cell-proliferation from germ-wall (Randwulst). The germ-ring also receives abundant additions from the overlying primary germ-layer, even at considerable distance from the periphery. (See Reinhard, Arch. f. Mikr. Anat., 1898.)

8. The whole germ-ring, extra-embryonic as well as embryonic, contains both entodermal and mesodermal elements (*contra* H. V. Wilson and Samassa).

9. Kupffer's vesicle arises, as in the Salmonidæ, as a cavity completely shut in by cells from the first. It is at first much compressed horizontally and distinctly bilobed. In embryos with a short tail it is still to be seen near tip of the latter, strongly suggesting neurenteric canal of Selachii. A second vesicle, situated in yolk under the posterior end of the embryo, appears slightly in advance of Kupffer's vesicle and reaches a size exceeding the latter. It is bounded by periblast and perhaps contains more fluid yolk for service of the growing end of embryo.

Respiratory and Breeding Habits of Polypterus Bichir. N. R. Harrington.

On physiological grounds *Polypterus* is as fully qualified for a 'lung-fish' as are any of the Dipnoans; it has also striking resemblances in its circulatory and respiratory system to the *Urodela*. These points were demonstrated by means of mounted preparations, the injecting of which had been done in the field principally by Dr. Reid Hunt.

Beside the blood-supply to the lungs (which is from the last branchial arch), the dissections showed the very large *glottis*, or ductus pneumaticus, by which the lungs open ventrally from the œsophagus. Unlike the swimming-bladder of fishes in another respect, both the lungs are entirely invested with peritoneum, although one of them, the right, does occupy the normal position for an air-bladder, viz., between the aorta and kidneys, on the one hand, and the alimentary canal, on the other. The mesentery, however, in which the left lobe should be suspended, has almost entirely degenerated, and this somewhat smaller lobe lies entirely free in the body-cavity.

It was pointed out that, while the strongest disproof of the Dipnoan ancestry of the Amphibia lies in the paleontological evidence which indicates that they are a parallel line, the same conclusion may be in-

ferred from the life habits of a form which encysts during periods of drought. For the ability to undergo suspended animation necessitates such specialization that it is improbable that evolution operated through such an encysting form (which is absolutely helpless and inactive until it is set free into the water), in bringing about a vertebrate which breathed air the year around.

Reference was also made to the breeding habits of *Polypterus*, and an accessory copulatory organ in the male—a modified anal fin—was described. The breeding season follows the inundation of the Nile.

The general collections, some of which were exhibited, brought back by the Senff zoological expedition, are intended for general distribution to qualified investigators, who can work up the material within a reasonably short time. Aside from a large collection of Nile fishes, there is material preserved for researches in embryology, electric organs, pseudo-electric organs, neurology and Plankton.

The Coronary Vessels in the Hearts of Fishes. G. H. PARKER and F. K. DAVIS.

THE muscular substance of the heart in mammals receives its blood from a pair of coronary arteries which connect with coronary veins opening into the right auricle. The inner surfaces of the four chambers of the mammalian heart have upon them openings which lead into vessels connecting with the coronary capillaries, and especially with the veins. These vessels are the veins of *Thebesius*. Is there a similar system of vessels in fishes? Coronary arteries were identified in the common skate, the sand shark and the mudfish (*Amia*). In the skate they may come from various combinations of the efferent branchial arteries of the second to the fifth gill cleft; in the sand shark, from combinations reaching from the first to the fifth clefts; in the mudfish, from the second branchial arch. In these three species coronary veins occur, all of which open into the venous sinus. On inflating these, bubbling was observed from the natural inner surfaces of the auricles and sometimes from those of the ventricles. These fishes, therefore, have veins of *Thebesius*.

Longitudinal Fission in Metridium marginatum. G. H. PARKER.

TEN animals with double mouths were studied. Two had each two mouths on one oral disc, and the pedal ends of their œsophageal tubes were united. Eight had each completely separate oral discs and œsophageal tubes. In six the mouths were monoglyphic; in three one mouth was monoglyphic and one diglyphic, and in one one mouth was monoglyphic and one aglyphic. There were about twice as many pairs of complete mesenteries as in single mouthed individuals. Double specimens are not the result of fusion, for the two partial individuals are strikingly similar in color, etc., a condition unlikely of occurrence in chance combinations of so variable a species. They may be monstrosities or dividing animals. One specimen nearly divided was kept under observation two months, but showed no advance in the process. In good collecting localities isolated pairs agreeing in color, marking and sex may be found. This evidence favors the view that *M. marginatum* reproduces, by longitudinal fission, a process slowly accomplished, but it does not exclude the possibility of some double specimens being monstrosities.

Additional Characters of Diplodocus. HENRY F. OSBORN.

THIS is one of the three types of herbivorous Sauropoda or Cetiosauria, represented by a very considerable portion of the skeleton of one individual found by Barnum Brown and the writer in 1897. The scapula, ilium, ischium and femur are associated with

a remarkable vertebral series extending from the 5th dorsal to the end of the tail: (1) The center of motion is the sacrum, where three vertebræ are completely coalesced to the summits of the spines, besides a fourth rib-bearing sacral with a free spine. The sacro-iliac union is by means of both ribs and neuropophysial plates. The presence of such plates in all the anterior caudals, as first described by the writer, proves that the sacrum is reenforced by additions from the anterior caudals. (2) There are more than thirty caudals and three distinct types of chevron, instead of the single type to which Marsh applied the generic name *Diplodocus*. The tail was undoubtedly a powerful swimming organ and also a lever by means of which the anterior portion of the body was elevated, the acetabulum serving as a fulcrum, while the trunk was immersed in water. This power did not exist upon land as in the Iguanodontia.

The Ossicula Auditus of the Mammalia. J. S. Kingsley and W. H. Ruddich.

Studies on embryo pigs and rats show that the incus is the quadrate, the malleus, the proximal end of Meckel's cartilage. These cannot be homologized with the columellar chain of Sauropsida, since they are in front of the spiracular cleft and in front of the chorda tympani, while the columella is behind the spiracle and chorda tympani. The incus (quadrate) articulates with the stapes in the mammals, exactly as is the case in the urodeles. Nothing similar occurs in the Sauropsida. This is regarded as additional evidence that the mammals have had an amphibian ancestry. The quadrate cannot have disappeared in the glenoid fossa, as maintained by Albrecht and Cope, as this would involve a translation of parts impossible to explain. The mammalian lower jaw articulates by means of the dentary rather than by means of the articulalare, *i. e.*, its articulation is not homologous with that in lower groups. A longer summary of the paper will appear in the *American Naturalist* for March.

Notes on Mammalian Embryology. C. S. Minot. (Read by title.)

Professor O. van der Stricht's Researches on the Human Ovum. C. S. Minot. (Read by title.)

Notes on the Morphology of the Chick Brain. S. P. Gage.

A Specific Case of the Elimination of the Unfit. H. C. Bumpus.

The results of a comparative study of one hundred and thirty-six English sparrows, which were rendered helpless or actually perished during the severe storm of February last, was numerically expressed, and it was shown that there was not only a measurable but a striking physical difference between the birds which actually succumbed and those which survived the storm. The birds which perished were longer, heavier, possessed of shorter heads, shorter leg bones, of less breadth of skull and of reduced sternum, while those which survived tended toward the possession of characters opposite to these.

While these average differences between the two groups of birds were emphasized, attention was also called to the fact that the individuals of extreme variability occurred most frequently among the birds which perished. The longest bird and the shortest bird in the entire collection perished. The same is true of the one having the greatest and the one having the least alar extent. The heaviest bird died; the one with the longest and the one with the shortest head died, and the one with the shortest humerus, the one with the longest femur, the one with the longest and the one with the shortest skull, and the one with the shortest keel to

its sternum—all died. The average oscillation of variation around an ideal mean was also shown to be almost invariably in excess for the birds which perished, and the conclusions arrived at were as follows:

The birds which perished were not simply accidental sufferers from the severity of the storm, but were birds which were physically disqualified for enduring the intensity of the New England climate, as expressed by the storm of February 1st, and they were consequently eliminated by natural agents. The result of this elimination produced in this particular locality a colony of birds measurably different from those existing before the storm, that is, the action of natural selection resulted in the elimination of the unfit and the survival of the fit.

On the Anatomy of the Spermatozoon of Invertebrates. G. W. FIELD. (With demonstration of the apical body.)

THE widest diversity in the form of the spermatozoon is found among the different groups of the invertebrated animals. Closer examination shows that there is, however, one type of form which obtains in by far the greater majority of species, and that the aberrant forms are peculiar to those species which have either become parasitic, *e. g.*, certain worms and arthropods, or which have acquired specially modified secondary sexual organs, *e. g.*, lobster, crayfish, *Limulus*.

The common type is the familiar tailed form, prevalent one in the groups Cœlenterata, Vermes, Echinoderma, Mollusca, Arthropoda and Tunicata. The three general divisions are usually distinct and readily recognizable Rarely the spermatozoa of all the species studied have a special structure or apical body at the anterior tip of the head. It has been variously described as (1) an adaptation for boring into the egg; (2) a remnant of the cytoplasm; (3) fluid expressed from the nucleus upon shrivelling; (4) a micropore surrounded by 'Ringkörper;' (5) an apical button present in the unripe spermatozoon; (6) the sperm centrosome. The first five opinions seem to have little importance when considered in connection with the origin of this apical body. While the opinion of myself and others that it is the sperm centrosome is refuted by the weight of evidence that the sperm centrosome comes from the middle piece of the spermatozoon, yet, so far as I know, the function of this apical body has not been noted by any of those who have studied so successfully the fertilization process. Since it has the same microchemical reactions and the same origin as as the middle piece, it would appear as if its fate must be of considerable consequence. I have found this apical body in more than forty species, representing all the groups from the Cœlenterates to Amphioxus (including Toxopneustes). By others it has been found in upwards of twenty additional species.

The fact that the apical body is present in the spermatozoon of well-nigh every species studied indicates that it has some very special significance which should not be overlooked by workers on the phenomena of fertilization.

The Middle Piece of the Urodele Spermatozoön. J. H. MCGREGOR. (Read by title.)

The Origin of the Yolk in the Egg of Molgula. HENRY E. CRAMPTON, JR.

THE author presented the principal results of an extended study upon the early history of the ascidian oöcyte, considered from a chemical as well as from a purely morphological aspect, made by means of carefully controlled aniline staining supported by artificial digestion and other tests. It was found that the cell-body at the beginning of enlargement of the primary oöcyte presents no albumen reaction. There is, however, a small albuminous gran-

ular body formed just outside the nucleus, which enlarges by the addition of granules similar to those found in the nucleus, until it becomes first a cap-shaped mass and finally surrounds the nucleus. *1st Period: Formation of the 'yolk-mass.'* This body then disintegrates, the constituent granules being spread evenly throughout the now highly vacuolated cell-body. The latter was shown to be composed probably of a pseudo-nuclein. *2d Period: Disintegration of the yolk-mass.* The ovum assumes its final character by the progressive vacuolization of the cell-body, and by the enlargement of the products of disintegration of the 'yolk-mass' to form the definite 'deutoplasm' spheres. *3d Period:* The original was considered to be of nuclear origin, and is probably what has been loosely homologized in some cases with the 'corps vitellin de Balbiani,' etc.

Protoplasmic Movement as a Factor of Differentiation. Edwin G. Conklin.

Various factors have been suggested by different persons as the causes of differentiation, but so far no one has shown that the active movements of protoplasm constitute such a factor.

The polarity of the egg and the specializations of cleavage are two of the earliest differentiations of the developing organism. In the gasteropod *Crepidula* both of these differentiations are associated with definite and orderly movements of the protoplasm.

Before the maturation the germinal vesicle lies near the center of the egg and the yolk is uniformly distributed. With the appearance of the centrosomes and the formation of the first maturation spindle the nuclear membrane is broken opposite the poles of the spindle, nuclear sap escapes into the cell and at the same time the nucleus, spindle and surrounding cytoplasm are carried bodily toward the surface of the egg. Coincidently with this migration of the nuclear constituents there is a segregation of the cytoplasm at one pole (the animal) and of yolk at the other (the vegetal). This separation of yolk and cytoplasm goes on during the second maturation division and throughout all the stages of fertilization. The movements of the germinal vesicle and of the maturation spindles, the separation of yolk and cytoplasm and also the approach of the pronuclei during fertilization seem to be due to protoplasmic currents.

In the cleavage of the egg the evidence for such currents is much more abundant and complete. Centrosomes and *Zwischenkörpern* are preserved throughout the resting period following division, and by means of the relative positions of these bodies at different stages, as well as the relative positions of the nuclei, yolk and cytoplasm, the direction and extent of these movements can be accurately determined. During the anaphase of the first cleavage the spindle lies at right angles to the egg axis, and the centrosomes, chromatic plates and *Zwischenkörper* are in a straight line. In later stages the *Zwischenkörper* is carried down to the center of the egg, the centrosomes are carried up to the surface and move toward each other until they come to lie on each side of the first cleavage plane and immediately under the polar bodies; the nuclei are also moved upward and toward each other until they are almost in contact on opposite sides of the first cleavage wall, and the cytoplasm moves down into the center of the egg, the yolk at the same time moving up at the periphery. Such movements could be caused only by vortical currents in the daughter cells moving up at the surface and down through the center of the egg; the cell wall forms where these opposite currents meet.

Similar vortical currents occur in every cleavage up to a late stage, and they offer most important evidence not only as to the mechanics of cleavage, but also as to the me-

chanics of differentiation. Of the four commonly recognized features of differential cleavage—viz.: (1) inequality, (2) non-alternation of directions, (3) qualitative differentiation and (4) lack of rhythm—the first three may be correlated with these movements. Unequal cleavages are due to movements which, beginning with the early anaphase, carry the nucleus out of the center of the cell. Non-alternation is due to the absence of currents, alternation to the regular reversal of currents during each successive division. Certain qualitative differences of the two daughter cells of every cleavage are also due to these movements. The remains of the centrosphere (idiosome of Meves, mother periplast of Vejdovski) in each blastomere is carried by definite rotations of the protoplasm into one only of the two daughter cells into which the blastomere divides; there is thus produced by protoplastic movement a visible qualitative difference in the two daughter cells formed at every division.

The Characteristics of Mitosis and Amitosis. S. WATASÉ.

On Hæmatococcus. F. H. HERRICK.

OBSERVATIONS on Hæmatococcus began with Girod-Chantrans in 1797 and have been continued during the present century by Agardh, Cohn, Braun, Rostafinski, Bütschli and others. The chief points of contention lie in the supposed sexual character of this organism and in the structure and functions of the zoospores.

The following summary of results was presented: (1) Resting cells after long submergence in water lose the power of development. In one case, after being submerged for two years, the cells have greatly thickened walls, but no zoospores are formed. If these cells are now dried, even for a short time, and then returned to water development rapidly follows. Hæmatococcus has thus become adapted to the alternation of drought and moisture, so that desiccation or something equivalent to this has become necessary to bring about a normal response. (2) Great variation not only occurs in the form and size of the sporangium (developing mother cell wall) and in the number of the zoospores, but in the size of the zoospores produced in the same sporangium. In respect to size at least the terms 'macrozoospore' and 'microzoospore' have no significance. (3) The zoospores imbibe water after liberation and undergo marked changes in appearance. Before maintaining that all zoospores have a similar structure, it may be necessary to repeat and extend certain experiments, but we are convinced that no sexuality can be attributed to this form, and that no true copulation has ever been observed. (4) Monstrosities frequently occur in the motile stage, such as twins and cells with four or more 'heads' (pairs of flagella) in all cases due not to *fusion*, but to incomplete division of the mother cell. (5) Reproduction by internal cell division has been observed in the motile stage in a few cases, in one of which the zoospore-colony consisted of four small cells freely moving in the sac of the mother zoospore, which was itself distinctly propelled by its own cilia. The mother capsule soon burst setting the young free. (6) When a motile cell comes to rest its protoplasmic sac contracts and a spherical resting cell is formed which secretes its proper wall while still enclosed in the evanescent wall of the zoospore. The flagella break at the 'beak,' leaving two slender rods united with the wall of the metamorphosed zoospore. These are probably elastic cellulose tubes which serve to sustain the flagella at the points where they pierce the sac. (7) In the course of zoospore-formation in large cells endosmosis is very great and the surface tension of the wall unequal. The transparent sphere is blown out in a form often resembling that of an incandescent light bulb, with abundant room for the

active cells. The wall at the small end of the bulb is still very thick, and at the moment of bursting suddenly contracts and scatters the zoospores with a rush. (8) Under various conditions direct development of resting cell from resting cell seems to occur. This looks like a process of arrested development of zoospores, in which cell division is complete, but the characteristics of the motile cell do not appear.

BASHFORD DEAN,
Secretary.

COLUMBIA UNIVERSITY.

(*To be concluded.*)

ASSOCIATION OF AMERICAN ANATOMISTS.

THE eleventh annual session was held in New York City, December 28th–30th, in conjunction with the 'Naturalists' and other affiliated societies. Most of the meetings were held at the Medical Department of Columbia University. Forty-one members attended and 20 new members joined, making a total of 141, of whom 10 are honorary. The localities and names of the new members are as follows: From Ann Arbor, Professor J. P. McMurrich, University of Michigan; from Baltimore, Professors F. P. Mall and L. F. Barker and associate R. G. Harrison, of the Johns Hopkins University; from Buffalo, Dr. N. S. Russell, assistant in anatomy, University of Buffalo; from Ithaca, Dr. L. Coville, lecturer and demonstrator in anatomy, Cornell University Medical College; from Montreal, Dr. J. G. MacCarthy, senior demonstrator of anatomy, McGill University; from New York City, Professor J. D. Erdmann, of Bellevue Medical College; Dr. Evelyn Garrigues, assistant demonstrator of anatomy, Woman's Medical College; Dr. Ales Hrdlicka, associate in anthropology, Pathological Institute of New York Hospitals; and the following assistant demonstrators of anatomy in Columbia University: Doctors G. E. Brewer, C. Carmalt, H. D. Collins, G. W. Crary, W. Martin, W. H. Rockwell and A. S. Vosburgh; from Philadelphia, Professor J. C. Heisler, of the Medico-Chirurgical College; from Savannah, Dr. E. R. Corson; from Washington, D. C., Dr. C. I. West, demonstrator and lecturer in topographical anatomy, Howard University.

The address of the President, Dr. Burt G. Wilder, discussed, 'Misapprehensions as to the Simplified Nomenclature;' the speaker urged especially a fuller recognition of what had been done by the English anatomists, Barclay, Owen, Pye-Smith and T. Jeffery Parker, and hoped the nomenclature of the future would be called the 'Anglo-American.'

The Association voted that abstracts of papers be required in advance, and that brief abstracts be included in the program; that the time for reading papers be limited to thirty minutes; that the Secretary-Treasurer be allowed his railroad fare and ten dollars toward his hotel expenses at each meeting. The Association also accepted the propositions of the editors of the (English) *Journal of Anatomy and Physiology* as to making that journal the official organ of the Association, and nominated Professor George S. Huntington as the American editor. The details of the arrangement will be given in a circular to be issued by the Secretary of the Association. Dr. E. W. Holmes, of Philadelphia, was elected member of the Executive Committee, and the President was authorized to fill the vacancy in the Committee on Anatomical Nomenclature caused by the resignation of Dr. Dwight.*

The subject assigned for discussion, 'The Teaching of Anatomy in Our Medical Schools,' was opened by Dr. Holmes; 'The Defects of our Present Methods,' and further considered under ten divisions, viz: (1) Preparatory education. (2) The value and place

* Dr. E. C. Spitzka, of New York City, has since been selected.

of General Biology and Comparative Anatomy. (3) Histology and Embryology in the medical course. (4) The relative value of didactic methods. (5) Practical Anatomy and how to teach it. (6) The order of topics. (7) The correlation of structure and function in teaching. (8) The use of charts and blackboards. (9) The qualifications requisite for a teacher of anatomy. (10) The desirability of terminologic consistency; by Dr. Gerrish (4, 6 and 8), by Dr. Huntington (2, 3, 5 and 6), and by Dr. Wilder (10). In view of the extent and importance of the subject it was suggested that at future meetings a smaller number of divisions be more fully considered.

The following papers were read and discussed; all were illustrated by specimens and charts or photographs, and several by lantern-slides or enlarged photographic projections: By J. A. Blake, 'The roof and lateral recesses of the fourth ventricle considered morphologically and embryologically;' by G. E. Brewer, 'Preliminary report on the surgical relations of the duodenal orifice of the common bile-duct;' by E. R. Corson, 'An X-ray study of the normal movements of the carpal bones and wrist;' by F. Dexter, 'Morphology of the digestive tract of the cat;' by T. Dwight, 'The origin of numerical variations of the vertebræ,' and 'The living model showing the platysma in contraction;' by S. H. Gage, 'Further notes on the relation of the ureters and great veins;' by I. S. Haynes, 'An explanation of a new method of cutting gross sections of the cadaver, with demonstration of the technique;' by Ales Hrdlicka, 'The normal human tibia;' by G. S. Huntington, 'Morphology and phylogeny of the vertebrate ileo-colic junction,' 'Visceral and vascular variations in human anatomy,' and 'the sternalis muscle;' by W. Martin, 'The cæcum and appendix in 100 subjects;' by J. J. MacCarthy, 'The internal structure of the hippocampus;' by B. B. Stroud, 'Note on the staining of isolated nerve-cells,' and 'Preliminary account of the degenerations in the central nervous system of frogs deprived of the cerebrum;' by B. G. Wilder, 'Some current misapprehensions as to the objects of the Cornell collection of brains.' For lack of time there were read by title only Dr. Wilder's paper, 'Further tabulation and interpretation of the paroccipital fissure (occipital division of the intraparietal complex);' three papers by Dr. Huntington, 'The genito-urinary system of the American pit-viper,' 'Contribution to the anatomy of the reptilian vascular system,' 'Cerebral fissures and visceral anatomy of the Eskimo from Smith's Sound;' and Dr. Haynes' discussion of teaching.

At its closing session, December 30th, the Association adopted, without dissent, the report of the Committee on Anatomical Nomenclature presented by the majority (Gerrish, Huntington and Wilder). It comprises four divisions, viz:

A. Brief statement of reasons for preferring certain terms (about fifty in number) already adopted by the Association.

B. Recommendation of *mesocælia* as a name for the cavity of the mesencephalon, with reasons therefor.

C. Recommendation of 181 names of bones (120) and muscles (61) identical with those in the B. N. A. (Basel Nomina anatomica).*

D. Recommendation of 17 names of bones and muscles differing from those of the B. N. A.

D. S. LAMB,
Secretary.

* Die anatomische Nomenclatur. Nomina anatomica, Verzeichniss der von der Anatomischen Gesellschaft auf ihrer IX. Versammlung in Basel angenommenen Namen. Eingeleitet und im Einverständniss mit dem Redactionsausschuss erlaütert von Wilhelm His. Archiv. für Anatomie und Physiologie. Anat. Abth., Supplement Band, 1895. O, pp. 180; 27 Figs., 2 plates.

AMERICAN MATHEMATICAL SOCIETY.

The regular meetings of the American Mathematical Society were formerly held at monthly intervals from October to May, the program being readily disposed of in a single afternoon session. A summer meeting, occupying two days, was also held, usually in connection with that of the American Association. At the Buffalo meeting in 1896 and the Boston meeting in 1898 a colloquium, or course of lectures on recent developments in mathematics, was also provided. With the growth of the Society in maturity and productiveness it was found advisable about two years ago to modify this plan so far as concerned the winter meetings. In order to make the individual meetings more prominent and to secure them a concentration of interest, it was decided that they should be held at intervals of two months, viz., on the last Saturday of October, February and April, and on a variable day in the last week of December. In compensation for the reduction in the number of meetings, provision was made for two sessions at each meeting, to be held in the morning and afternoon. About the same time the Chicago Section was organized, and its April and December meetings have proved valuable additions to the Society's activities. The results have fully justified the wisdom of the new departure. The attendance has greatly increased, the number of papers presented at each meeting has quadrupled, and the meetings have become more substantial and active centers of mathematical intercourse. This remarkable advance is in one way occasioning the Society a delectable embarrassment. The number of papers offered for presentation is becoming so great that the two sessions of the meetings no longer furnish anything like adequate time for their reading and discussion. It will apparently soon be necessary to provide longer or more frequent meetings, against both of which suggestions valid objections can be urged. Another consequence of this profusion of mathematical riches is the growing inadequacy of the present facilities for publication of original mathematical articles in the country. The *Bulletin* of the Society was established as a journal of critical and historical investigation, and although, by the publication of a great number of shorter original articles, it has widely departed from its original purpose, it is no longer able to keep pace with the steadily increasing output without sacrificing its proper functions, a course which cannot be permitted. The Council of the Society has, therefore, had for some time under consideration the question of providing better facilities for publication, and is at present seriously contemplating the periodical publication of Transactions of the Society. This is a project very near to the hearts of many influential and productive members of the Society, and the enthusiasm which it has aroused has again contributed to stimulate the energies of the Society and affords gratifying evidence that the undertaking will be successfully carried through.

A regular meeting of the Society was held at Columbia University on Saturday, February 25th. The total attendance at the two sessions was forty-seven, including thirty-nine members of the Society. President R. S. Woodward, who has succeeded President Simon Newcomb, occupied the chair. The Council announced the election of the following persons to membership in the Society: Mr. John B. Faught, Bloomington, Ind.; Professor Edward B. Fishburne, Waynesboro', Va.; Professor William P. Graham, Syracuse, N. Y.; Dr. Waldemar Schulz, Ithaca, N. Y.; Dr. Ernest J. Wilczynski, Berkeley, Cal. Four nominations for membership were received. An amendment to the constitution was adopted, by which retiring Presidents of the Society

are retained in the Council for one year after retirement.

The following papers were read at the meeting:

(1) PROFESSOR M. I. PUPIN: 'Electrical oscillations on a loaded conductor.'

(2) PROFESSOR MAXIME BÔCHER: 'An elementary proof that Bessel's functions of the zeroth order have an infinite number of real roots.'

(3) PROFESSOR J. M. PEIRCE: 'Determinants of quaternions.'

(4) PROFESSOR HENRY TABER: 'The chief theorem of the theory of finite continuous groups.'

(5) PROFESSOR ALEXANDER MACFARLANE: 'On the imaginary of geometry.'

(6) PROFESSOR EDGAR ODELL LOVETT: 'On a certain class of differential invariants.'

(7) PROFESSOR JAMES PIERPONT: 'On arithmetizing mathematics.'

(8) DR. VIRGIL SNYDER: 'Lines of curvature on annular surfaces having two spherical directrices.'

(9) PROFESSOR W. F. OSGOOD: 'On a continuous function of a real variable whose derivative cannot be integrated.'

(10) PROFESSOR ERNEST W. BROWN: 'On the progress of the calculations in the new lunar theory.

(11) PROFESSOR M. I. PUPIN: 'Lagrange's equations and the principle of equality of action.'

(12) PROFESSOR E. B. VAN VLECK: 'On the determination of a series of Sturm's functions by the computation of a single determinant.'

(13) DR. G. A. MILLER: 'On the primitive groups of degree 17.'

(14) DR. L. E. DICKSON: 'Concerning the abelian and hypoabelian groups.'

(15) DR. F. H. SAFFORD: 'Surfaces of revolution in the theory of Lamé's products.'

(16) DR. D. F. CAMPBELL: 'On linear differential equations of the third and fourth orders in whose solutions exist certain homogeneous relations.'

(17) MR. E. R. HEDRICK: 'On three-dimensional determinants.'

(18) DR. G. H. LING: 'An examination of groups whose orders lie between 1093 and 2000.'

(19) PROFESSOR A. G. WEBSTER: 'Traces illustrating the motion of the top.'

The next meeting of the Society will be held on Saturday, April 29th. The Chicago Section meets at the University of Chicago on Saturday, April 1st.

F. N. COLE,
Secretary.

THE NOMENCLATURE OF THE HYOID IN BIRDS.

THE hyoid apparatus of birds is so simple a structure, one so long known and so well studied, that it would naturally be supposed anatomists might agree upon the names of its component parts. Those who have occasion to refer to anatomical text-books, however, are well aware that there is a surprising, not to say bewildering, variation in the nomenclature used by different authors, as a glance at the accompanying figure and table of names will make apparent.

It is quite evident that all of these names cannot be correct, and a little reflection will show some of the changes that are certainly needed, and others that probably should be made. Taking the last first, let us consider that part, B, termed urohyal by Mivart and Gadow. The urohyal of fishes is a membrane bone developed beneath the anterior portion of the branchial arches; hence, it is quite evident that the name cannot be consistently applied to a cartilage bone at the posterior end of the branchial apparatus, and that Parker's term, second basibranchial, should stand. Equally simple is the case of the paired bones, D, called basibranchials by Gadow and hypobranchials by Beddard. Basibranchials are unpaired bones developed in the median line, and the term is inapplicable to paired bones lying on either side of an unpaired basal bone. As for hypobranchials, these are among the first seg-

ments of a branchial arch to disappear, not being developed even in tailed amphibians, and it will be safe to call the lower portion of the posterior arch of the hyoid a ceratobranchial, and the adjoining segment an epibranchial. The anterior pair of bones, in the body of the tongue, C, are naturally ceratohyals.

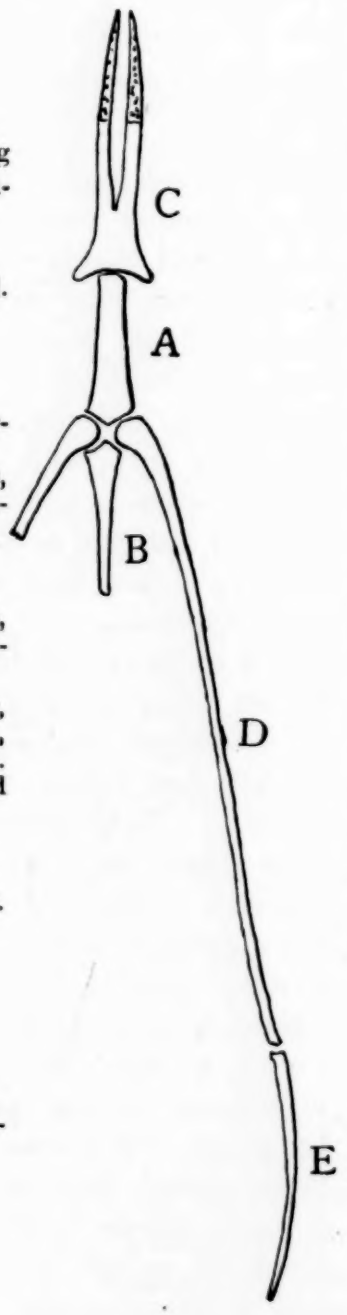

FIG. 1.

Hyoid of Grebe showing component bones, much enlarged.

A First basibranchial.
B Second basibranchial.
C Ceratohyals.
D Ceratobranchials.
E Epibranchials.

A { Basibranchial: Parker. Basihyal: Mivart, Gadow, Beddard-figure.
B { Basibranchial 2: Parker. Urohyal: Mivart, Gadow, Beddard.
C { Ceratohyal: Parker, Mivart, Gadow, Beddard in part. Basihyal: Beddard in part.
D { Ceratobranchial: Parker. Thyrohyal: Mivart. Basibranchial: Gadow. Hypobranchial: Beddard.
E { Epibranchial: Parker. Ceratobranchial: Gadow, Beddard.

The next question, that of the proper name for the anterior basal bone of the hyoid, A, calls for some reflection, since it involves not only the nomenclature of the hyoid in birds, but in mammals as well. This bone is called basibranchial by Parker and basihyal by Gadow, this latter name being ordinarily used for the basal bone of the mammalian hyoid.

A true basihyal, or as it is better called from its relations, glossohyal, is found in fishes at the upper, anterior portion of the hyoid apparatus. It is also present in turtles, where it has the same relation to the tongue as in fishes, and where it ossifies some little time after the first basibranchial, with which it soon becomes confluent. It seems a little doubtful if a true basihyal occurs among birds, although the median piece of cartilage contained in the fleshy portion of the tongue and articulating with the fused ceratohyals in such birds as ducks may represent this bone. The question is one which the embryologist can readily answer. As pointed out by Parker, the true basihyal does not occur in mammals, the term being given to a bone that is morphologically the first basibranchial. It would seem that exact morphological nomenclature should reject the term basihyal for the first basal median bone in the hyoid of birds and mammals, including, of course, man, as there is no reason why human anatomy should stand as a stumbling block in the way of the student of comparative anatomy, although it has often done so.

F. A. LUCAS.

SCIENTIFIC BOOKS.

A Treatise on Universal Algebra. By A. N. WHITEHEAD, M.A., Fellow and Lecturer of Trinity College, Cambridge. Cambridge, University Press; New York, The Macmillan Co. Vol. I. Pp. xxvii+586. Price, $7.50.

By 'Universal Algebra' is meant the various systems of symbolic reasoning allied to ordinary algebra, the chief examples being Hamilton's Quaternions, Grassmann's Calculus of Extension and Boole's Symbolic Logic. The present volume contains an exposition of the general principles of universal algebra, followed by a

separate detailed study of the Algebra of Logic and of the Calculus of Extension; the second volume will contain a separate detailed study of Quaternions and Matrices and a detailed comparison of the symbolic structures of the several algebras. The main idea of the work is not unification of the several methods, nor generalization of ordinary algebra so as to include them, but rather the comparative study of their several structures. But, it may be asked, if the branches of universal algebra are essentially distinct from ordinary algebra and from one another, what bond is there to connect them into one whole? A connecting bond is found in the generalized conception of space; the properties and operations involved in that conception are found capable of forming a uniform method of interpretation of the various algebras.

The work is well and clearly written and, when completed, will form an admirable presentation of the subject from the formal view of mathematical analysis. One excellent feature is conservatism in the use of symbols; by this means the author makes his pages easier reading to those who have already studied some of the special branches.

Another excellent feature of the volume consists in the Historical Notes appended to some of the chapters. In these Mr. Whitehead gives a brief history of the development of the special branch, so far as known to him, without making an exhaustive research. The importance of the Historical Notes probably calls for a more exhaustive research, as the work covers a great and growing province of mathematics and will, when completed, be considered one of the best authorities on its subject in the English language.

The feature which is most open to discussion is the view which the author takes of the fundamental nature of mathematics; and it is most important, for it determines the whole plan of the work. In the preface the author thus states his view, in very plain terms: "Mathematics is the development of all types of formal, necessary, deductive reasoning. The reasoning is formal in the sense that the meaning of propositions forms no part of the investigation. The sole concern of mathematics is the inference of proposition from proposition. The justification of the rules of inference in any branch of mathematics is not properly part of mathematics; it is the business of experience or philosophy. The business of mathematics is simply to follow the rules. In this sense all mathematical reasoning is necessary, namely, it has followed the rules. Mathematical reasoning is deductive in the sense that it is based upon definitions which, as far as the validity of the reasoning is concerned (apart from any existential import), need only the test of self-consistency. Thus no external verification of definitions is required by mathematics as long as it is considered merely as mathematics. Mathematical definitions either possess an existential import or are conventional. A mathematical definition with an existential import is the result of an act of pure abstraction. Such definitions are the starting points of applied mathematical sciences; and, in so far as they are given this existential import, they require for verification more than the mere test of self-consistency. Hence a branch of applied mathematics, in so far as it is applied, is not merely deductive, unless in some sense the definitions are held to be guaranteed *a priori* as being true in addition to being self-consistent. A conventional mathematical definition has no existential import. It sets before the mind, by an act of imagination, a set of things with fully-defined self-consistent types of relation. In order that a mathematical science of any importance may be founded upon conventional definitions, the entities created by them must have properties which bear some affinity to the properties of existing things. Thus the distinction between a mathematical definition with an existential import and a conventional definition is not always very obvious from the form in which they are stated. In such a case the definitions and resulting propositions can be construed either as referring to a world of ideas created by convention or as referring exactly or approximately to the world of existing things."

In reply, it may be asked: Is geometry a part of pure mathematics? Its definitions have a very existential import; its terms are not conventions, but denote true ideas; its propositions

are more than self-consistent—they are true or false; and the axioms in accordance with which the reasoning is conducted correspond to universal properties of space. But suppose that we confine our attention to algebraical analysis—to what the treatise before us includes under the terms ordinary algebra and universal algebra. Are the definitions of ordinary algebra merely self-consistent conventions? Are its propositions merely formal without any objective truth? Are the rules according to which it proceeds arbitrary selections of the mind? If the definitions and rules are arbitrary, what is the chance of their applying to anything useful? The theory of probabilities informs us that the chance must be infinitesimal, and the author admits that the entities created by the conventions must have properties which bear some affinity to the properties of existing things, if the algebra so founded is to be of any importance. The author says 'some affinity;' it may be asked how much? Unless the affinity or correspondence is perfect, how can the one apply to the other? How can this perfect correspondence be secured, except by the conventions being real definitions, the equations true propositions, and the rules expressions of universal properties? In the last sentence quoted, Mr. Whitehead makes a large concession to the realist view; it is only necessary to change the sentence into—"In the case of any algebra worthy of scientific attention the definitions and propositions refer exactly or approximately to the world of existing things."

M. Laisant, in his recent work, 'La Mathematique,' refers to the formal view of mathematical science when discussing the theory of fractions, p. 35. He opposes it, as marching in the direction opposite to progress, and as a survival of the spirit of the sophist.

The realist view of mathematical science has commended itself to me ever since I made an exact analysis of Relationship and devised a calculus which provides a notation for any relationship, can express in the form of an equation the relationship existing between any two persons, and provides rules by means of which a single equation may be transformed, or a number of equations combined so as to yield any equation involved in their being true simultaneously. The notation is made to fit the subject, and the rules for manipulation are derived from universal physiological laws and the more arbitrary laws of marriage. A very real basis, yet the analysis has all the characteristics of a calculus, and throws light by comparison on several points in ordinary algebra.

But what is the subject of which ordinary algebra is the analysis? Quantity; and in space we have the most complex kind of quantity; so that if space can be analyzed, the analysis will serve for any less complex kind of quantity. Mr. Whitehead admits that, as a matter of history, mathematics has till recently been the science of number, quantity and the space of common experience. But "the introduction of the complex quantity of ordinary algebra, an entity which is evidently based upon conventional definitions, gave rise to the wider mathematical science of to-day. Ordinary algebra, in its modern development, is a large body of propositions interrelated by deductive reasoning and based upon conventional definitions which are generalizations of fundamental conceptions."

The imaginary quantity, more generally the complex quantity, of ordinary algebra is the foundation upon which the formalist builds his theory; if it can be shown that it is not an entity based upon conventional definitions, but corresponds to a reality, then his whole superstructure falls down. The complex quantity first arises in analysis in the solution of the quadratic equation. The general form of the root consists of a quantity independent of the radical sign and a quantity affected by the radical sign. When the quantity under the radical sign is negative the root is said to be imaginary, because it appears to be incapable of direct addition to the part independent of the radical sign. In certain papers recently published I have shown at length that the root of a quadratic equation may be versor in nature or scalar in nature. If it is versor in nature, then the part affected by the radical involves the axis perpendicular to the plane of reference, and this is so, whether the radical involves the square root of minus one or not. In the former case the versor is circular, in the latter hyperbolic. When the root is scalar in its nature

the two parts add to form the final result, but in the case where the square root of minus one is present the sign must be preserved in the intermediate processes of calculation. A complex index (both terms involving a sign of direction) has its meaning in an angle which is partly circular, partly hyperbolic; and a scalar complex quantity expresses the cosine or sine of such complex angle. It follows that the functions of a complex quantity can be defined really. It has been the practice of writers to follow the formal view, and define, for instance, the cosine of a complex quantity as the sum of a certain infinite series. Let z denote a complex quantity, then, according to that view, by cos z is meant the sum of the series

$$1-\frac{z^2}{2!}+\frac{z^4}{4!}-\text{etc.}$$

But when the cosine of a complex angle is defined in the same manner as the cosine of a circular angle or of a hyperbolic angle, namely, as the ratio of the projection of the radius-vector to the initial line, then

$$\cos z=1-\frac{z^2}{2!}+\frac{z^4}{4!}-\text{etc.},$$

becomes not a dead convention, but a living truth.

In the first book the author states more fully the principles of universal algebra: "There are certain general definitions which hold for any process of addition and others which hold for any process of multiplication. These are the general principles of any branch of universal algebra. But beyond these general definitions there are other special definitions which define special kinds of addition or multiplication. The development and comparison of these special kinds of addition or of multiplication form special branches of universal algebra," p. 18. The general principles are as follows: Addition follows the commutative and associative laws, viz: $a+b=b+a$ and $(a+b)+c=a+(b+c)$. Multiplication follows the distributive law, viz: $a(c+d)=ac+ad$ and $(a+b)c=ac+bc$. Multiplication does not necessarily follow the commutative and associative laws, that is, $ab=ba$ and $(ab)c=a(bc)$ are laws of special branches only. It has been maintained by followers of Hamilton that the associative law is essential to multiplication. It is true of spherical quaternions, but is not true of the complementary branch of vector analysis. It is satisfactory to find that Mr. Whitehead adopts the latter view, and, indeed, it is involved in his detailed exposition of vector analysis in the concluding book of his first volume.

But one who looks upon algebraic analysis not as the sum of several correlated branches, but as one logical whole, must consider the above principles or so-called definitions as arbitrary. For let p and q denote two quaternions, then e^pe^q is not in general equal to e^qe^p; consequently e^{p+q} is not equal to e^{q+p}; hence the commutative law does not hold in the addition of these indices. Thus to define addition as necessarily following the commutative law, and multiplication as not necessarily following it, is an arbitrary procedure.

In expounding the algebra of logic the author follows largely the exposition of Dr. Schroeder in his learned treatise, 'Vorlesungen über die Algebra der Logik,' but he does not take up the most valuable part of that work, namely, the Algebra of Relatives. Symbolic Logic as expounded by Schroeder differs essentially from the calculus devised by Boole in his 'Laws of Thought.' It was Boole's aim to keep as close as possible to ordinary algebra, and to make his method the foundation of a calculus of probabilities. In fact, the full title of his famous book is 'An Investigation of the Laws of Thought on which are founded the mathematical theories of Logic and Probabilities.' According to Boole the special peculiarity of the algebra is that $x^2=x$, when x is an elementary elective symbol. Jevons is said to have introduced the further supposed law that $x+x=x$, which destroys the quantitative character of the calculus. Indeed, Mr. Whitehead says that the algebra is non-numerical, and in Dr. Schroeder's elaborate work no mention is made of probabilities. According to the more recent school $a-b$ supposes that b is included in a (p. 82), whereas Boole made no such limitation. It is a step backwards, just as it would be a step backwards in ordinary algebra to hold that $a-b$ carries the supposition that b is less than a.

The detailed exposition of Grassmann's system is excellent and will be welcomed by all who wish to assimilate the ideas of that great master of space-analysis. The last book of the present volume is on the application of the calculus of extension to geometry, and it is evident from the fourth chapter, entitled 'On Pure Vector Formulæ,' that the author considers vector analysis to be supplementary to quaternion analysis. They are not the same thing; and both gain when it is perceived that they are not redundant, but supplementary to one another.

In conclusion, the work reflects great credit on the author and on the Cambridge University Press; it is likely to lead to further advances in Universal Algebra, not only by what it lays down, but by the questions which it brings forward for discussion.

ALEXANDER MACFARLANE.

The Principles of Agriculture. By L. H. BAILEY. New York, The Macmillan Company. 1898. Pp. xx + 300.

'Principles of Agriculture,' by Professor L. H. Bailey and his associates in Cornell University, is a new volume in the Rural Science Series and in many respects is the most important one of the series, as it serves as an introduction to the others. The book is intended to be used as a text-book for schools and rural societies, but it will prove interesting and valuable for the agriculturally inclined who have had little or no training in the natural sciences. It is essentially a book for beginners, and as such serves its purpose better than any of the small handbooks which have attempted to treat of the elementary principles of agricultural science.

The volume is edited by Professor Bailey and some of the chapters are written by him; the remaining chapters are written by his associates, who are specialists in the departments of which they have written. At the end of each chapter are suggestions which serve to elucidate the text for readers whose knowledge of natural science or of rural affairs is scanty, and also give useful hints for teachers who may use the volume as a text-book.

In the introduction we are told that "agriculture is not itself a science, but a mosaic of many sciences, arts and activities, or, a composite of sciences and arts, much as medicine and surgery are. * * * But the prosecution of agriculture must be scientific." The aim of the book is to deal with 'fundamentals' rather than 'incidentals.' "The mistake is often made of teaching how to overcome obstacles before explaining why obstacles are obstacles. * * * The purpose of education is to improve the farmer and not the farm." Would that more of our farmers could see the truth contained in these statements.

The book opens with a brief treatment of the formation of the different kinds of soils. On page 27 the author says: "The profit in agriculture often lies in making the soil produce more abundantly than it is of itself able to do." On page 202: "In intensive and specialty farming manures may be bought." These statements are true, but do not consist well with what is said about ideal agriculture on page 2. Inorganic compounds are explained as those which are not produced by living organisms, and phosphoric acid is given as one example, notwithstanding that a large amount of phosphoric acid used in commercial fertilizers is made from bone. Although the chemists call it an inorganic compound, yet because it is found in the remains of animals the reader who has had no knowledge of chemistry might be puzzled until some further explanation was made.

The second chapter, which is written by Professor Spencer, shows what is meant by 'texture' of the soil, why good texture is important and how to obtain it. That "the texture or physical condition of the soil is nearly always more important than its mere richness in plant food" is a fact not recognized by some tillers of the soil.

The 'moisture of the soil' and 'tillage' are next treated in a brief and creditable manner. Several figures are given to illustrate the art of plowing and one of an 'ideal general purpose plow.' All plowmen will think that this implement might be improved upon, but the low handles should be appreciated by everyone. The handles of many plows are too far from the ground.

Chapters IV. and V. treat of enriching the

soil. The former explains the method of handling home-made manure, while the latter has to do with commercial fertilizers only. Fig. 31 shows a 'common type of barnyard,' in which home-made fertilizers are allowed to go to waste, while in Fig. 30 is shown a model method of protecting them; yet the position of the watering trough is not an ideal one, looking at it from a sanitary point of view. Fig. 32 shows a 'handy and economical stable,' which, in reality, is anything but desirable. It might do for a makeshift while refitting an old barn, but it cannot be recommended to anyone who is planning to erect a new set of buildings.

Other chapters deal with plants, their propagation and subsequent care. It is misleading to say that germs or bacteria may cause constitutional troubles in the plant, as is done on page 167 and again on page 170, where we read that constitutional diseases are usually treated by burning the affected parts, which implies that such a plant may spread the disease if not destroyed. It is hard to see how a disease inherent in a plant (constitutional) can spread the disease to other plants, unless the affected parts of the diseased plant are used for propagation. Bacterial diseases may affect the internal structure of the host, although 'the cause of it is not apparent on the exterior,' yet such diseases are not constitutional any more than the diseases caused by the Peronosporiaceæ. Some biologists deny that there are any true constitutional diseases, while here we have constitutional diseases treated as something different from contagious diseases, but what that something is is not very clear.

The life-history of one parasitic fungus given in detail would have been a valuable addition, for it would have helped much to explain *why* it is that one plant can cause sickness in another, a fact which is hard for any person to understand who has not viewed microscopic preparations of fungi. In doing this the author would have followed out the aim 'to seek why before seek how,' as stated on page 15.

Contact insecticides is a better term than 'caustic insecticides,' for in many cases the insecticide clogs the breathing pores and causes death by suffiocation rather than by caustic action on the tissues. Figs. 70 and 71 pretend to show sucking and biting insects respectively, but the reader will not be able to see the distinction from the illustrations.

Many farmers would think twice before following the advice on page 187: "If the meadow fails to return two tons of field-dried hay to the acre, plow it up," for there are local conditions where less than two tons per acre may be a justifiable crop.

Chapter XIV., 'How the Animal Lives,' by Professor Law, and Chapter XV., 'The Feeding of Animals,' by Professor Wing, give summaries of our present knowledge of subjects of which our farmers, as a rule, do not know nearly so much as they should.

The last chapter, on the 'Management of Stock,' is by Professor Roberts. On page 266 he says that there are two theories respecting the number of animals to be kept on a farm. The fact is we are beyond the theory stage in this matter, and it can be said curtly that there are two methods, the practice of either one of which must depend upon local conditions.

The severest criticism to be made of the book is that nearly every subject discussed in it is treated in too brief a manner, a result inevitable in trying to expound the principles of agriculture in one book of only 300 small pages, printed in large type. This defect has been partially remedied by references to other literature for further study, although it is to be regretted that these references are confined mainly to the work of the editor's immediate associates. The arrangement of the contents is excellent, and on the whole the book is superior to any of its kind.

In closing, we quote again from the preface: "Agriculture is a business, not a science. * * * Business cannot be taught in a book like this; but some of the laws of science as applied to farm management can be taught."

ELISHA WILSON MORSE.

Elementary Zoology. By FRANK E. BEDDARD. New York, Longmans, Green & Company. 1898. 12mo. Pp. vi+208. 93 illustrations.

Every teacher examines with interest any new text-book dealing with the subject in which he gives instruction, and his interest is all the greater if the book is written by a recog-

nized authority and published by a reputable firm. He may find that the book treats the subject in a more satisfactory manner than the text he has been using, and hence be led to change. Or, if he cannot adopt the new book, he may learn from it much that is inspiring and suggestive of better methods of teaching. There are far too many teachers, however, who, having to give instruction in several subjects, have not become especially proficient in any one and are not fitted by experience and training to be competent judges of the merits of different texts. Zoology is one of those studies which are usually 'lumped' together and put into the hands of the 'teacher of science,' who, more often than not, is a physicist or a chemist by training and, consequently, not likely to be qualified to select a good text-book in zoology. Too often is the choice determined by the scientific reputation of the author, who may be of undisputed ability as an investigator, but not successful in his method of presenting his subject; or by the business enterprise of the book agent. Hence, it behooves those who are interested in raising the grade of instruction in the different scientific branches to exercise a careful watch to prevent, if possible, the introduction of text-books, and especially such as are elementary, which are faulty in method and inaccurate in the statement of facts. There is no reason why a new text-book should be issued unless it present the subject by a better method and be a distinct advance over those already published.

This elementary zoology "contains an account of a few types selected from the chief groups of the animal kingdom, followed and accompanied by a consideration of some of the more general conclusions of biology." The author adopts the very commendable plan of treating the types in the ascending order, beginning with a discussion of protoplasm and the amœba. The fifteen chapters of the book deal with the unicellular animals; hydra; earthworm; crayfish; cockroach; metamorphoses of insects; pond mussel; snail; frog; skeletal and integumentary structures of vertebrates; the egg, sperm, and development of the chick; morphology of organs; morphology of tissues; classification; classification of animals. The most of these topics are discussed with a tolerable degree of clearness, although paragraphs are not infrequent which must be read more than once before the meaning is grasped.

It is questionable whether an average high-school pupil could comprehend the author's treatment of the morphology of the skull and the development of the chick. The first cannot be understood without much elaborate dissection and comparison of specimens, nor the second without the use of sections, and the reconstruction of the latter either into a model or in the imagination is not within the capacity of the beginner.

There are so many grammatical and typographical errors that one is forced to believe that the book was carelessly written and hastily printed. For instance, a singular verb is not infrequently burdened with a plurality of subjects. The unbiased reader has his choice between 'spermathical' and 'spermathecal' pores in the earthworm. Hydra is figured as containing 'interstital' cells and 'chromatphores,' and anodon as having a 'coelome.' Several figures, *e. g.*, 8 and 9, do not tally with their descriptions. Modifications of Maupas' figures of the conjugation of vorticella are given, but no description of the process accompanies them. The directions for preparing dissections are not always accurate. On p. 23 it is stated that 'when an earthworm is opened by a median incision along the back, and the flaps of skin turned back, the entire anatomy is revealed.' The student will find it necessary to do more than this before he will discover the nervous system. Again, on p. 63, 'when the mantle flap of one side is removed the structures shown in Fig. 29 are brought into view.' The pupil who accepts this statement in good faith will look in vain for the liver, pedal ganglion, connectives and commissures shown in the illustration. An anodon shell with the lines of growth running 'parallel with the long axis of the shell' (p. 62) would be a prize for any conchologist. The explanation of the gaping of the mussel shell after death (p. 62) has the advantage of novelty, if not of verity. It is interesting, too, to learn that the snail is a symmetrical animal, that its radula bears calcified teeth (p. 68) and that the blue color of its blood is due to the presence of 'hæncyanin,' p. 70.

English frogs have the tongue 'bifid at the tip,' and breathe in an uncommonly awkward manner. "When the frog breathes it fills the mouth with air; the mouth is then closed and the external nares, while the muscles forming the floor of the mouth force the contained air into the lungs" (p. 80). In the tadpole, respiration is carried on by a 'free flow of oxygen containing water over the gills.' The adult frogs are said to have 'two first vertebræ,' from which the student infers that they are double headed. On p. 103 the author says: "The skeleton of the fore limb consists of the pectoral girdle and of the limb which articulates with it." The student is left to wonder which of the two limbs enjoys this distinction and why the other is not equally favored.

Nothing is said about geographical distribution; sponges are nowhere mentioned; in the chapter on histology there is no figure or description of bone, no figure of nerve cells or fibers, of striated muscle fibers, of glandular structures, nor of adipose tissue. There is no index. Most of the figures are good, but there are not enough to make certain of the subjects clear to beginners.

There would be no excuse for giving Mr. Beddard's zoology an extended notice were it not that the scientific prominence of its author and name of its publishers are likely to carry much weight and to lead to its introduction into American schools in the place of other and better books, and this should not happen until it has been given a thorough and radical revision.

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Laboratory Exercises in Anatomy and Physiology. By JAMES EDWARD PEABODY, A.M., Instructor in Biology in the High School for Boys and Girls, New York City. New York, Henry Holt & Co. 1898. Pp. x + 79.

In view of the large amount of instruction in physiology that is given in secondary schools and the large number of text-books that exist, it is surprising how few attempts have been made to treat the subject practically by the preparation of laboratory directions. And the few attempts, although in several cases excellent, are, without exception, inadequate. The immediate cause of this state of things is probably the lack of a demand by teachers for aids of this kind; and this lack of demand is probably to be traced to a lack of realization on the part of the majority of the teachers, themselves imperfectly trained in this respect, of the advantages of the practical method. Not a few teachers, however, have longed for help in endeavoring to raise the standard of instruction in this branch from its present alcoholic and narcotic condition, and such progressive ones will heartily welcome Mr. Peabody's book.

The book is apparently intended for high-school classes. Among the subjects treated are the human and mammalian skeleton, the muscles, the chemical testing of foods, digestion, absorption, the heart, the blood and its circulation, oxidation, respiration, the skin, the kidney, excretion, touch, taste, smell, yeast and bacteria. Directions for the use of the microscope and a list of apparatus and chemicals required for the exercises are added. The book is interleaved with blank pages for notes and is intended to be placed in the hands of the pupil. The latter is given simple directions for experimenting and, instead of being told what to observe, is asked concerning the results that follow. In this respect the book is in accord with the best of the practical guides in other departments of science. "The questions * * * have been framed with the object of leading the student to seek the facts *from the material itself.* The student should be trained especially to distinguish in the experiments *observed results* from the *inferences* that may be drawn from those results." This admirable intention is well carried out. To illustrate the care with which it is done one instance may be cited. After giving directions for making and using the common bell-jar apparatus to demonstrate the action of the diaphragm and lungs, the author asks the pertinent questions: "In what respects does this model illustrate the process of inhaling and exhaling air in our own bodies? In what respects does the model fail to illustrate the process of respiration?"

The book is preeminently a guide to the study of human physiology, and a large number of the experiments and observations are to be

made on the pupil's own body. It is interesting to see how much pure physiology, as distinct from anatomy, can be learned in this way, without the aid of complex apparatus, dissection or vivisection. Vivisection is neither employed nor referred to in any way in the book, and dissection only as it pertains to bones, muscles, the heart and the kidney. Anatomy is treated not as a finality, but as a basis for the study of function. The directions for the study of bacteria are excellent, and the practical applications of bacteriology include, among other things, the canning of fruits, the use of the tooth-brush, the cleaning of the streets, and the cleansing of wounds.

In the opinion of the reviewer physiology is usually taught in high-school courses too much as a human, and too little as a broadly biological, science. Hence some regret is unavoidable that in the present book more attention is not given to the comparative aspect. Notwithstanding this lack, the book is thorough, is calculated to arouse the interest and even the enthusiasm of the pupil, and is to be heartily recommended for use in schools.

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BOOKS RECEIVED.

A Text-book of General Physics. CHARLES S. HASTINGS and FREDERICK E. BEACH. Boston, Ginn & Co. 1899. Pp. viii + 768. $2.95.

The Development of English Thought. SIMON N. PATTON. New York and London, The Macmillan Company. 1899. Pp. xxvii + 415.

The Shifting and Incidence of Taxation. EDWIN R. A. SELIGMAN. New York and London, The Macmillan Company. 1899. Pp. xii + 337. $3.00.

The Cambridge Natural History. Volume IX., Birds. A. H. EVANS. London and New York, The Macmillan Company. 1899. Pp. xvi + 635. $3.50.

The Elements of Physical Chemistry. J. LIVINGSTON R. MORGAN. New York, John Wiley & Sons; London, Chapman & Hall, Ltd. 1899. Pp. xiii + 299.

Examination of Water. WILLIAM P. MASON. New York, John Wiley & Sons; London, Chapman & Hall. 1899. Pp. 135.

De la méthode dans la psychologie des sentiments. F. RAUH. Paris, Alcan. 1899. Pp. 305.

SOCIETIES AND ACADEMIES.

THE BIOLOGICAL SOCIETY OF WASHINGTON.

THE 19th anniversary meeting was held January 17th, under the auspices of the Washington Academy of Sciences, in the hall of the Columbian University, the occasion being the address of the retiring President, Dr. L. O. Howard, entitled 'Are Insects as a Class Injurious or Beneficial in their Relations with Man?' The paper was published in full in SCIENCE for February 17th.

The 301st regular meeting was held January 28th and was devoted to a consideration of the 'Great Dismal Swamp.' Dr. David White traced the geologic history of the swamp and surrounding regions, showing how successive periods of elevation and depression had resulted in the formation of a considerable area so slightly elevated above sea-level that the natural drainage is insufficient to remove the rainfall. It was stated that the present period is considered to be one of subsidence, and it was noted by later speakers that Lake Drummond is evidently increasing in size.

Mr. F. D. Gardner described the soils from a practical standpoint, with special regard to the agricultural possibilities of the land extensively reclaimed by drainage. Large deposits of peat exist, which it has not been found possible to utilize on a commercial scale. The water of the streams and drainage ditches is very strongly impregnated with the soluble products of the enormous quantities of decomposing vegetable matter, and, like the soil, has a distinctly acid reaction. This acidity of the soil may be so excessive as to interfere with its fertility, although inexhaustible quantities of plant foods are present.

Mr. Thomas H. Kearney exhibited a large series of photographs illustrating the characteristics of the flora of the swamp. The various plant-associations were enumerated and described at length, and their relative importance in the formation of humus was noted. Reference was also made to the possible effects of the acidity and generally low temperature of the water as agents likely to retard growth and to require adaptations against excessive transpiration. The woody type of vegetation predominates, there being very few herbaceous species

and these invariably perennials. Bulbs and creeping rootstocks occur, but the cespitose habit so common among dry-land plants is entirely absent. Notwithstanding the abundance of climbing woody vines and bamboo-like Arundinarias which give an aspect of tropical luxuriance, the flora is predominantly boreal in origin. Many northern plants have their southern limit of distribution here, and, on the other hand, several southern types have never been found farther north.

Mr. William Palmer continued Dr. White's discussion of the physiography, with particular reference to the changes due to human agencies. The vegetation becomes very dense along canals and ditches where formerly the swamp was comparatively open, as far as undergrowth was concerned. These ditching operations have been carried on since the days of George Washington, who spent considerable time in the Dismal Swamp in surveying and managing the work, and who died possessed of $2,000 in stock in the enterprise.

It was stated that the drainage of the swamp is very intricate, the direction of the current being not infrequently reversed in the same channel. Miocene bivalve shells are found in great abundance near the northern end of the Jericho Ditch. Of existing animals there are thirty mammals, the more prominent of which are deer, opossums and wild cattle. Forty-one species of birds are regular summer residents, with many more transient visitors. The most characteristic bird of the swamp is perhaps the Prothonotary Warbler, a rare bird everywhere else, but not uncommon in the swamp. The resident birds and mammals in some instances show distinct characters, by which they may be readily separated from those of the neighboring drier regions, and have consequently been described as distinct species or subspecies. Fourteen species of fish are known from the waters of the swamp, although it is believed that none existed in Lake Drummond until admitted through the canals. Snakes may be said to be abundant, as Mr. Palmer has counted 153 while passing along one of the canals on a warm day. The King Snake is very tame and sometimes climbs into boats, but with no malicious intentions. Four frogs and six turtles were also enumerated.

In conclusion, Mr. Palmer stated his regret that the opportunity of holding the vicinity of Lake Drummond as a National Park had not been improved before its great natural beauties were so largely destroyed.

The 302d regular meeting was held February 11th, but, owing to the unusually severe and inclement weather, the attendance was small, and several members who had arranged to continue the discussion of the Great Dismal Swamp were absent. After electing to active membership Dr. Oscar Loew, of Washington, and Lieutenant Wirt Robinson, of New York, the Society voted to postpone the discussion and adjourn.

O. F. COOK,
Corresponding Secretary.

CHEMICAL SOCIETY OF WASHINGTON.

THE regular meeting was held on January 12, 1899.

The first paper of the evening was read by Dr. E. A. de Schweinitz, and was entitled 'The Serum Treatment of Some Animal Diseases.'

In this paper the author gave a general review of the work begun in 1890 in the study of the substances secreted by the hog cholera and the swine plague germ in relation to immunity. He further pointed out the production of an enzyme by the hog cholera and other allied germs, and their importance in producing in animals immunity from disease. From this point the work was extended to a study of the serum obtained from animals that had been immunized to disease, and this was found to contain an immunizing principle and exerted curative properties upon experimental animals affected with hog cholera and swine plague respectively. Following these experiments, practical work has been carried out in the field for several years, with very satisfactory results. The treatment with serum was found to save about 80 per cent. of infected herds, while in those herds not treated which served as checks the loss from disease was over 80 per cent.

In practical work in the field it is difficult to decide often whether the animals are suffering from either hog cholera or swine plague alone or both of these diseases. To overcome this difficulty it has appeared advisable to use a

curative serum for one of these diseases mixed with a curative serum for the other. For protective vaccination it appears advisable to use, in addition to the serum, the products of the bacteria as well as their cell contents, including the products of the secretion or excretion.

The second paper of the evening was read by Dr. F. K. Cameron, and was entitled 'On the Estimation of Nicotine,' by E. A. de Schweinitz, J. A. Emory and F. K. Cameron.

This paper described a critical examination of the analytical methods so far proposed, and with special reference to the so-called 'Kissling Method.' Attempts to devise a satisfactory method were made by formation of double salts with metallic compounds, precipitation of an addition compound with bromine or iodine, precipitation with picric acid, precipitation with phosphomolybdic or phosphotungstic acid, decomposition of accompanying amines with nitrous acid, decomposition of these compounds with hypochlorous or hypobromous acid, separation of the ammonia as oxalate by the addition of alcohol. The results were summed up as follows:

I. The so-called Kissling method was to be regarded as the best so far proposed. For the estimation of nicotine in tobacco leaves or powders it may be regarded as satisfactory, but its application to tobacco extracts yields very unreliable results.

II. A complete extraction of nicotine by ether and some other solvents is readily accomplished.

III. An evaporation of an ether extract will afford a practicable separation from ammonia alone, but not from other organic bases.

IV. A complete separation by distillation with steam is much more difficult than is usually supposed. Certain deviations from the usual practice were suggested.

V. No method involving the precipitation of the nicotine as an insoluble compound has been found practicable.

VI. No method involving the decomposition of accompanying compounds has been found practicable.

VII. The presence of tertiary amines, and probably some pyridin derivatives in tobacco extracts, is as yet an insurmountable obstacle in the separation or estimation of nicotine.

Finally, it is to be observed that nicotine comports itself as a tertiary amine. It does not yield a nitroso compound. Its separation from ammonia, primary and secondary amines, can be more or less readily accomplished by the adaptation of well-known general methods. Its separation from tertiary bases must be dependent on the discovery of some accidental physical or chemical property of the substance involved which cannot be predicated from known general principles. It would seem that a satisfactory solution of the problem is dependent upon some empirical relation, and it is in this direction that further investigation is indicated. But it is to be hoped that a more profound study of nicotine itself will yield satisfactory evidence as to its true nature, and from the knowledge thus gained the problem before the analyst may not be so aimless or complicated as it now seems.

William H. Krug.
Secretary.

Meeting of the New York Section of the American Chemical Society.

The February meeting of the New York Section of the American Chemical Society was held on the 10th inst., in the Assembly Room of the Chemists' Club, at 108 West 55th street, Dr. Wm. McMurtrie presiding. In accordance with a resolution adopted by the Washington Section, it was resolved "that it be recommended to the Council that the Society confer, through appropriate channels, with the Chemical Society of London, as to the feasibility of the separate publication of their abstracts after the manner of the *Chemische Centralblatt*, the preparation of these abstracts to be undertaken by both Societies conjointly."

A report from the Committee on Patent Legislation was read, recommending that the present Committee be continued, with five additional members to be appointed by the chair.

The duty of the Committee will be to prepare such alterations and amendments as may seem advisable and submit them to the different members of the Committee as well as to the Sections of the Society before the first spring meetings. From the reports of the Sections in different parts of the country a general report will be

prepared for the next session of Congress in December.

The following papers were read:

'Recent Extension of Our Knowledge Regarding Nitrates as Plant Food,' Dr. J. A. Myers.

'A Method for the Analysis of Canned Condensed Milk,' F. S. Hyde.

'Manufacture of Ether,' Alfred Roos.

'Manufacture of a New Guaicol Compound,' L. H. Reuter.

'Explosibility of Nitrogen Iodide and Acetylene Copper Compounds and Use of the Latter in Manufacture of Alcohol and Ether,' L. H. Reuter.

'Chemistry of the Dynamite Process of Weighting Silk,' Rafael Granja.

'Chemistry of the Velocitan Process—Quick Tanning,' Rafael Granja.

'Melting Point as a Cyclic Function,' Thos. Bayley, England. Read by title.

DURAND WOODMAN,
Secretary.

GEOLOGICAL CONFERENCE AND STUDENTS' CLUB OF HARVARD UNIVERSITY.

Geological Conference, January 10, 1899.—Dr. T. A. Jaggar, Jr. gave a communication on 'The Geology of the Northern Black Hills,' and illustrated it with many lantern views, photographs and specimens. He dwelt especially on certain facts, discovered by him during the past summer, which throw new light on the general problem of intrusives. These will be published in full later.

Students' Geological Club, January 17, 1899.—In a paper entitled 'Our Present Knowledge of the Geology of the Boston Basin,' Mr. R. E. Burke briefly summarized the literature on the geology of that area.

Geological Conference, January 24, 1899.—Mr. H. T. Burr presented some results obtained in mapping the conglomerates of the Boston Area with a view to determining their relative age. The Commonwealth Avenue cut in the Roxbury conglomerate shows a series which strikes transversely (E–W) to similar, adjoining conglomerates to the north and south. Evidence was offered to show that this structure is due to overthrusting from the north followed by normal faulting.

The Brighton amygdaloids have generally been considered as flows. The speaker held, after a detailed study of their contacts, that these rocks are intrusive. Further, their injection was probably preceded by faulting.

In discussing this paper, Professor Shaler favored the division of the Roxbury conglomerates into formations, on the basis of recognized periods of denudation that alternated with periods of deposition.

Mr. Robert DeC. Ward spoke on 'Acclimatization of the White Man in the Tropics.' By acclimatization is meant adaptation to a new climate. This problem, although an old one for Europeans, has confronted us for only a few months. It arises as a result of physiological changes that take place in the body, and may be best studied from two points of view, (1) a consideration of these physiological changes, and (2) a study of the diseases most prevalent in the tropics which a resident there is most likely to contract.

In connection with the former part of the problem the chief factors are heat and humidity. Heat, in itself, is not dangerous; but it becomes so when significant humidity is added. Heat induces evaporation and thus greater desire for drink. Accordingly, considering a certain increase in drink necessary, those nations which drink hard liquor will suffer more than those which use wine. Cereals afford safer food than meats. In regard, then, to both liquid and solid food the southern Europeans have advantages over the English. Too much or too little exercise is extremely dangerous; a certain amount is absolutely necessary. The most healthy tropical districts are high and dry.

In connection with the latter part of the problem, three diseases are especially prevalent, namely, sunstroke, yellow fever and malaria. Sunstroke is chiefly influenced by the rains. Malaria, the greatest obstacle in acclimatization, comes with the rains, but is also closely related to soil conditions. Yellow fever, although varying with the rainy season, finds its check in elevation. Thus, in the respective countries, the following altitudes have been found to be about the upper limit of that disease: in the United States, 800 feet; in Mexico, 2,300 feet; in Brazil, 2,700 feet; and in Jamaica, 4,000 feet.

The chief physiological changes resulting from life in the tropics are increased respiration and

perspiration, a more rapid pulse, enlargement of the liver, anæmia, and perhaps a rise of body temperature. Hygiene, as is shown by statistics, is effective in reducing the death rate, and thus in making life possible for white men in the tropics. While a strong person may, with proper care, live nearly anywhere in the tropics, he does not become independent of the tropical climate. Accordingly, authorities agree, with only a very few exceptions, that true acclimatization of the white man in the tropics is impossible.

J. M. Boutwell,
Recording Secretary.

ACADEMY OF NATURAL SCIENCES, OF PHILADELPHIA.

January 24, 1899. Mr. Witmer Stone made a communication on the Academy's collection of birds and its history. He quoted from Sclater to the effect that in 1852 the collection was the largest in existence. The work of American ornithologists from Alexander Wilson to those of our own time, most of whom had been more or less intimately associated with the Academy, was commented on and two of Wilson's types were exhibited. They were the only ones known to the speaker to be in existence, all the others having apparently been lost on the breaking up of Peale's Museum, of which they formed part. After commenting on the growth of the collection, Mr. Stone spoke of the modes of preservation and exhibition, dwelling on the advantage of keeping the bulk of the specimens as flattened skins in air-tight drawers. Fine specimens of recent taxidermic work were exhibited and contrasted with the 'stuffed' birds of half a century ago. The communication formed a most interesting contribution to the history of the Academy and will make part of the first number of the *Proceedings* for 1899.

A paper entitled 'Contributions to the Life-History of Plants, No. XIII.,' by Thomas Meehan, was presented for publication.

January 31. Professor Henry A. Pilsbry called attention to a small collection of shells from New Mexico and Arizona, received from Mr. Ashmun, whose zeal as a collector had increased the number of species of the region from about a dozen to over one hundred. The snails are almost entirely confined to the mountains and they exhibit the characters of forms from archipelagoes, only one species of a genus being found on one mountain range. Six species of *Pupa* were from six distinct localities.

Dr. P. P. Calvert commented on the influence of the heat of the room in hastening the development of dragon-flies from nymphæ.

A paper entitled 'A List of Fishes collected at Port Antonio, Jamaica,' by Henry M. Fowler, was presented for publication.

February 7. Messrs. George and William S. Vaux, Jr., made a communication on the Illecellewaet and Asulkan Glaciers of British Columbia. After Mr. George Vaux, Jr., had exhibited a large number of beautiful lantern views of the region, illustrating the distribution of peaks, glaciers and ranges, Mr. William S. Vaux, Jr., read a paper, which was afterwards presented for publication, describing in detail their investigations undertaken to determine the rate of recession of the two glaciers specially under consideration. The paper was also satisfactorily illustrated.

A paper entitled 'A New American Land-Shell,' by Edward G. Vanatta, was presented for publication.

February 14. Dr. P. P. Calvert called attention to the new catalogue of the dragon-flies of New Jersey, the section of the general catalogue of insects of that State confided to him by Professor J. B. Smith. The number of species of these insects has increased since the issue of the first catalogue in 1890 from 39 to 85. Middle-southern New Jersey has been touched but slightly and there is no doubt that other species will be added to the list.

Edw. J. Nolan,
Recording Secretary.

NOTES ON PHYSICS.

THE MEASUREMENT OF INDUCTANCE.

Of the various electrical measurements which serve in the electrical testing laboratory, the measurement of the inductance (the exact electrical analogue of the moment of inertia of a rotating wheel) of a coil of wire is perhaps the most unsatisfactory. Mr. H. Martienssen (*Wiedemann's Annalen*, 1899, No. 1) has im-

proved the little known method of Puluj for measuring inductance by means of alternating currents. The method of Puluj was devised independently by Professor S. T. Moreland and reported to Section B at the Boston meeting of the American Association. The method, in its simplest form, is to connect two circuits in parallel between alternating current mains and adjust non-inductive resistances until the currents in the two branches are in phase, when the inductances in the two branches are directly as the resistances. To show when the currents are in phase an instrument called a *phase indicator* is used. This instrument is essentially a small induction motor without iron. It consists of two small coils with their planes vertical and at right angles to each other, surrounding a suspended aluminum or copper rod. These coils are connected, one in each circuit, and when the two currents are not in phase with each other the suspended rod is deflected. Martienssen modifies the instrument by winding one coil with two strands of wire, each strand being provided with separate terminals. One of these strands he connects in circuit as before, and the other constitutes a secondary coil in which a current is induced by the current in the primary strand. This induced current is sensibly in quadrature with the primary current, and by the use of an adjustable non-inductive resistance in this secondary circuit the instrument may be used, according to Martienssen, for the accurate measurement of much smaller inductions.

Puluj's method, as modified by Martienssen, is a zero method; it requires only a single adjustment; it does not require harmonic electromotive force, nor does the frequency of the e. m. f. need to be known; and it gives accurate results for inductances ranging from a few hundreds to many millions of centimeters. In short, we seem to have at last a feasible laboratory method for the accurate measurement of inductance.

W. S. F.

NOTES ON INORGANIC CHEMISTRY.

AN interesting discussion has been carried on during the last few years as to the constitution of inorganic compounds, especially of the metal-ammonium bases, by Professor S. M. Jörgensen, of Copenhagen, and Professor Alfred Werner, of Zurich. Professor Jörgensen, to whom we owe so much of our knowledge of these bases, especially those of cobalt, chromium and rhodium, defends the constitution based on the present ideas of valence, which has been developed in its application to these compounds largely by himself on the basis furnished by Blomstrand. Professor Werner, feeling the insufficiency of the theories of valence to account for most of our complex inorganic compounds, has proposed a new theory of coordinated groupings, in which he seeks to account for the constitution not merely of the metal-ammonium bases, but also of all the complex inorganic compounds, including those containing water of crystallization. The last number of the *Zeitschrift für anorganische Chemie* contains the eleventh paper by Jörgensen and the fifteenth paper by Werner. In the former Jörgensen reviews Werner's theory, replies to all the objections Werner has raised to the valence theory as applied to the metal-ammonium compounds, shows the insufficiency of Werner's theory, and finally, by an ingenious piece of chemical logic, shows that Werner's own theory must, if consistently carried out, lead him to Jörgensen's own formulæ for these compounds. In this paper, and that of Reizenstein, recently mentioned in this column, one may get a good view of the arguments on both sides of the controversy.

WERNER'S paper in the same number of the *Zeitschrift* is confined to a study of the application of his theory to the double chlorids. He has tabulated all the double chlorids from the whole field of chemical literature, and grouped them in types according to his theory, considering also the water of crystallization present.

IT is yet too soon for any final judgment to be pronounced on Werner's theory, especially because the field to which it applies is so immense. The limitations of the valence theory are, however, only too keenly felt by chemists, and Werner's work is leading in the right direction. At all events, this lengthy controversy is productive of much good. It has turned the

minds of many chemists to the necessity of broader views of chemical compounds; it has stimulated many chemists to fuller investigations in the inorganic field, and it has led at the hands of the two leaders to a vast enrichment of our chemical knowledge of large classes of compounds. We may add that for the most part it has been conducted in the best spirit.

In the Trans-Caucasian region, from the Black Sea to the Caspian, are scattered many mud volcanoes, both in the naphtha regions and elsewhere. In the *Zeitschrift für anorganische Chemie*, P. Melikoff describes the analyses of the products of one of these mud volcanoes, that of Achtala. The principal ingredients of the water are salt and soda. The solid matter is chiefly a plastic clay, with fine grains of calcite, feldspar and quartz. The greater part of the paper is a discussion of the origin of the soda and of sodium carbonate deposits and waters in general. The experiments of the author show that in the presence of ferric or aluminum hydroxid, as well as of colloidal substances and zeolites of the soil, sodium sulfate and calcium bicarbonate react readily with formation of sodium carbonate, and the same is true of sodium chlorid and calcium bicarbonate. The hydroxid present, and in soils the colloidal substances, hold the reaction products with different degrees of firmness, preventing reverse reactions and allowing in natural leaching process the separation of these products. Thus in the latter reaction the ferric hydroxid has a greater capacity for absorbing soda than for calcium chlorid, hence the latter is first removed by washing, and the later wash waters contain largely soda. Similar reactions take place in the presence of ammonium carbonate, which is present in most soils. Thus the natural soda formation is attributable to the interaction of salt or sodium sulfate, on the carbonates dissolved in natural waters in the presence of the soil.

J. L. H.

CURRENT NOTES ON ANTHROPOLOGY.

LINGUISTICS OF THE CHACO.

The very few students of South American languages may be interested to learn that in the 'Proceedings' of the American Philosophical Society for October, 1898, I have published a paper of thirty pages, together with a linguistic map, on the languages of the Chaco region, embracing portions of the Argentine Republic, Paraguay, Brazil and Bolivia. The map covers the area from lat. 20° to 30° south, and long. 56° to 66° west from Greenwich. In this area the colors define the extensions of nine linguistic stocks, based on the most recent investigations. Especial interest attaches to the newly-found Ennima stock, first recognized as such by Guido Boggiari in 1895, although vocabularies of it had been printed before that date. While this paper does not solve all the problems of the Chaco tongues, it certainly diminishes their number.

THE CRANIOLOGY OF CRIMINALS.

What are the differences between the skulls of criminals and those of 'respectable people'? This is the question which M. E. Pitard undertook to solve by comparing the crania of fifty-one convicts who had died in the penal colony of New Caledonia, with the average crania of the citizens of Paris. Practically, there turned out to be no constant difference at all, unless it was that the vertical index of the criminal skulls was slightly higher; in other words, the convicts were 'brainier' than the good folks. There was also the same amount of variation in the heads of the criminals. Some were long, others broad-skulled; some had a notably large, others a small cubical capacity; these variations running parallel to those of the general population. M. Pitard's article, with abundant data, is in the *Bulletin* of the Anthropological Society of Paris, 1898, Fasc. 3.

THE FOLK-LORE OF THE FJORT.

This is the title of the latest volume issued by the Folklore Society of Great Britain. It is written by R. E. Dennett and edited by Miss Mary H. Kingsley. The 'Fjort' is the name applied to the negro tribes of the French Congo, who once formed the great native kingdom of Congo. The volume is much more than a collection of folk tales. Miss Kingsley in the introduction and the author in his commentary and notes furnish fresh and valuable information on the religious beliefs, marriage and burial customs and mode of life of these

semi-savage peoples. Their songs and stories are carried in the memory by strings of objects each of which corresponds to a heading or line. These songs take us into the arcanum of the savage mind and present a strange picture of its psychology. The volume is illustrated and forms a welcome addition to the series published by the Society.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

THE United States Fish Commission steamer *Fish Hawk* left Porto Rico for the United States on February 23d, having completed her work in the waters about the island and having visited all the principal ports. No details of the expedition have yet been received, but the most interesting results are expected from the operations on the sandy submarine plateau which extends to the eastward of the island.

THE French Geographical Society has awarded its medals, the two chief gold medals being given, respectively, to General Galliéni for his work in Madagascar and to M. E. Gentil for his explorations in Africa. The Félix Fournier prize has been awarded to M. Henri Brenier for commercial explorations in China.

MR. W. H. PREECE, C.B., F.R.S., having attained his sixty-fifth birthday, has retired from the position of Engineer-in-Chief and Electrician to the English Post Office, but it is hoped that his services will be retained by the Postmaster-General as consulting engineer.

PROFESSOR ALBERT F. BRIGHAM, of Colgate University, sailed on February 21st for Europe for ten months. He is now enjoying a sabbatical year, and will spend the time in geographical study in England and Switzerland, and in literary work for several months at Oxford. He will probably make arrangements to be with Professor Davis for a trip in the summer through parts of the Alps.

PROFESSOR R. VON WETTSTEIN, of Prague, has been appointed Director of the Botanical Gardens of Vienna and professor in the University.

PROFESSOR WALTER WISLICENUS, of the University of Strassburg, is intending, with the assistance of the German Astronomical Society, to prepare a yearbook of astronomy, giving abstracts of the papers appearing during each year, beginning with 1899.

THE death is announced of The Rev. William Colenso, F.R.S., at the age of 87 years. Mr. Colenso began life as a printer, and when the Church Missionary Society established a press in New Zealand, in 1833, he was given charge of this and became both printer and missionary. He was one of the chief authorities on Maori antiquities and rites, and on the natural history of New Zealand.

WE regret also to record the following deaths: Mr. John Kreusi, a mechanical engineer and inventor, at Schenectady, N. Y., on January 22d, aged 56 years; Mr. Thomas Cook, a well-known teacher of anatomy and writer on the subject, in London, on February 8th; Dr. L. A. Veitmeyer, a civil engineer at Berlin, and Dr. Carl Schoenlein, of the Zoological Station at Naples, at the age of 40 years.

THE New York Academy of Sciences proposes to hold its sixth annual exhibition in the American Museum of Natural History on April 11th and 12th. The first evening is reserved for members of the Academy and the second for the Scientific Alliance and friends of science in general. The afternoon of the 12th will offer an opportunity for students and those who cannot attend in the evening. The exhibition will illustrate the advances during the last year only. Any worker in the field of science who may have material which he believes of interest to the scientific world should communicate immediately with the chairman of the committee, Professor William Hallock, Columbia University, New York City. The exhibition is not limited to the work of members of the Academy, but the committee has final authority as to what material will be accepted. The departments represented are: Anatomy, astronomy, botany, chemistry, electricity, anthropology, ethnology, experimental psychology, geology, mineralogy, paleontology, photography, physics, physiography, physiology and zoology.

THE National Educational Association will meet next year in Chicago. Mr. A. B. Down-

ing, Superintendent of Normal Schools, New York City, has been elected President.

Officers for the International Association for Promoting the Study of Quaternions and Allied Systems of Mathematics for the years 1889 and 1900 have been elected as follows: *President*, Sir Robert Ball, of Cambridge University; *General Secretary*, Dr. Alexander Macfarlane, lecturer on mathematical physics in Lehigh University. The Secretary of the United States is Professor Arthur S. Hathaway, of the Rose Polytechnic Institute.

The Association of Polish Men of Science and Physicians will meet at Cracow in 1900. It will be remembered that the meeting in Posen last year was forbidden by the Prussian government for political reasons which scarcely appeared to be sufficient.

The British Board of Agriculture have appointed a Departmental Committee to inquire into and report upon the working of the Diseases of Animal Acts in so far as they relate to glanders, and to consider whether any more effective measures can, with advantage, be taken to prevent the spread of that disease. Lord Stanley is chairman of the committee.

A meeting of the Fellows of the Royal Botanic Society was held on February 11th, at the Gardens, Regent's-park, Mr. C. Brinsley Marlay presiding. Mrs. Ernest Hart exhibited a collection of Japanese dwarfed plants grown under certain secret methods much in vogue in the cultivation of trees in Japan. Each specimen was said to be upwards of one hundred years old, and the tallest was less than 18 in. in height, although possessing all the characteristics of perfect plants in miniature. They were pronounced to be the finest specimens of this peculiar art ever seen in England. There was also shown a seed incubator in action intended for use in connection with the 'Seed Control' lectures now being given in these Gardens every Monday.

The first ordinary meeting of the British Society of Engineers for the present year was held on February 6th. Mr. W. W. Beaumont, the President for 1898, occupied the chair and presented the premiums awarded for papers read during the year, viz., the President's gold medal to Mr. W. Fox, the Bessemer premium to Mr. S. O. Cowper-Coles, the Rawlinson premium to Dr. J. C. Thresh and a Society's premium to Mr. G. Thudichum. Mr. Beaumont introduced the President for the ensuing year, Mr. John Corry Fell, who delivered his inaugural address. He said, as reported in the London *Times*, that the financial position of the Society was very satisfactory, and it had increased its numbers during 1898. During the past year they had lost six of their honorary members—Sir William Anderson, Sir Henry Bessemer, Sir James N. Douglas, Sir John Fowler, Lord Playfair and Sir Robert Rawlinson. The vacancies thus created had been filled by Sir J. Wolfe Barry, Sir A. J. Durston, Sir David L. Salomons, Professor A. B. W. Kennedy, Mr. W. H. Preece and Mr. A. Siemens. It was a curious fact that civil engineers availed themselves less than any other members of the profession of the privileges accorded to inventors by patent, designs or copyright protection. It had been said that the British nation was less inventive than the American, and prior to 1883 that view appeared to be supported by the number of patent applicants in the United States as compared with those in Great Britain, but upon a reduction of the fees in 1883 the applications had reached over 30,000 per annum, and Great Britain now took a foremost place in the inventive world. With regard to successful invention the conditions should be the result of analysis or synthesis, not mere chance dashes into an unknown field. Mr. Fell pointed out the necessity of having a special Court for the trial of patent actions. He had for long past been of opinion that such a Court should be established, and of late the Lord Chancellor and other Judges had expressed the same views. They had publicly attributed the block in the Law Courts to the increasing number of patent cases and the inordinate time many of them occupied. The President then gave a short summary of the advances made of late years in various departments of engineering. A hearty vote of thanks was accorded to Mr. Fell.

The annual meeting of the British Institution of Mechanical Engineers was held on February 9th at the new building in Storey's-gate, St. James's-park. Mr. S. W. Johnson, the re-

tiring President, being in the chair. Mr. Edgar Worthington, the Secretary, presented the 52d annual report, which showed that the membership in all classes had reached 2,684, representing a net gain of 191 on the previous year. The receipts for the year were £8,452, and the expenditure £7,588, leaving a balance of £863. The total investments and other assets amounted to £66,462. References were made to the experiments carried on by Professor Beare at University College as to the value of the steam-jackets, and to those of Sir William C. Roberts-Austen, who had carried to a successful conclusion a long series of experiments made at the Royal Mint on the behavior of steels during cooling. Congratulatory allusion was made to the summer meeting held at Derby, and it was stated that the next summer meeting would be held at Plymouth. The report was adopted, after which Mr. Johnson vacated the chair in favor of the President-elect, Sir. W. H. White. The fifth report of the Alloys Research Committee on Steel, drawn up by Sir William Roberts-Austen, was afterwards read.

A HYGIENIC institute is to be erected in Posen, Prussia. According to the *British Medical Journal* it will contain a hygienico-bacteriological and a pathologico-anatomical department, with the usual staff of directors and assistants. Their sphere of work is to comprise supervision and improvement of water supplies, of drainage works and the bestowal of refuse; soil and subsoil examination; hygienic supervision of works, factories, warehouses, etc.; prevention of the spread of infectious diseases; *post-mortem* examinations; courses of lectures, some popular, on subjects connected with hygiene, bacteriology and pathological anatomy. It is hoped that the scientifically-conducted efforts of the institute will be successful in arresting epidemics, such as cholera, smallpox, typhus, etc., which frequently have come into Prussia from across the Russian frontier.

THE *Times* states that at the South Foreland lighthouse, in the presence of representatives from the Councils of Dover, Ramsgate, Margate, Broadstairs, Sandgate, etc., trials have been made, under the supervision of Signor Marconi, of his system of telegraphing without wires, between the East Goodwin lightship, twelve miles out at sea, and the lighthouse. The system acted well, the messages being received and recorded on the tape with absolute accuracy, Signor Marconi had with him two assistants at the lighthouse, Messrs. Kemp and Cohen, and one on the lightship, Mr. Richards, but several of the messages were sent by men on the vessel who had been instructed in the work. The height of the pole used for transmission was 130 feet, and Signor Marconi considered that by this a message could be sent to the French coast. The receiving wire on the lightship was run 80 feet up the mast. During the recent severe weather the system has worked perfectly, and the men on the ship have sent messages that have been transmitted to Ramsgate. All present were impressed with the demonstration, and promises of support to a resolution urging the Board of Trade and the Admiralty to take up the system were given.

A LAW was recently passed in Norway, says the *New York Medical Record*, prohibiting the sale of tobacco to any boy under sixteen years of age without a signed order from an adult relative or employer. Even tourists who offer cigarettes to boys render themselves liable to prosecution. The police are instructed to confiscate the pipes, cigars and cigarettes of lads who smoke in the public streets. A fine for the offence is also imposed, which may be as much as twenty-five dollars.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. AGASSIZ AND HARVARD UNIVERSITY.

THE following minute on the Corporation records of Harvard University concerning the services and gifts of Mr. Alexander Agassiz are given in the Annual Report of President Eliot:

Voted, That in accepting from Mr. Alexander Agassiz the deed of gift which has been read, and which will be entered in full on the record of this date, the Corporation wish to enter on their records a statement of Mr. Agassiz's services and gifts to the Museum of Comparative Zoology:

From 1860 to 1865 Mr. Agassiz was Agent of the Museum and Assistant in charge of Worms, Echinoderms and Acalephs.

During part of the year 1866 he was in charge of the Museum while Professor Agassiz was absent in Brazil. In 1869, on his return from a three years' residence at Calamut, he was appointed Assistant in charge of Radiates, but without salary. Early in 1874 he was made a member of the Faculty of the Museum, Curator, and a member of the Board of Trustees. In 1876 the Museum was transferred to the University by its Trustees. Mr. Agassiz has never received any salary as Curator.

Between September 1, 1871, and September 1, 1897, Mr. Agassiz expended for the benefit of the Museum from his private means, without making any communication on the subject to the President and Fellows, over seven hundred and fifty thousand dollars, including his expenditures on objects now formally transferred to the Corporation, beside contributing about fifty thousand dollars to other University objects in gifts known at the time to the President and Fellows.

The great sum expended for the Museum is divisible into the following items which are taken from Mr. Agassiz's private accounts :

Land, Buildings and Fixtures	$219,007.00
Cases, Collections and care of same	223,867.00
Publications	118,127.00
Subscriptions to Agassiz Memorial Fund and for State grants (conditional)	65,000.00
Library	26,695.00
Salaries	27,051.00
Deficits Humboldt Fund (Students)	8,260.00
Fuel	7,807.00
Interest	9,568.00
Laboratory Supplies	3,100.00
Naples Table	1,473.00
Wood's Hole Fish Commission Tables	500.00
F. C. Gray Bust	355.00
Not analyzed ; old accounts not accessible	41,008.28
	$751,818.28

Of the total expenditure about $107,000 was for current expenses, or expenses which cannot now be specified ; the remainder is represented to-day by important parts of the land, building funds, collections, cases, fixtures, publications and library.

The Corporation record here their gratitude for these great gifts, distributed over a period of twenty-six years, and for devoted services rendered to the Museum in various capacities ever since 1860, with one interval of three years, 1866–1869.

THE CLIMATOLOGICAL LABORATORY OF THE UNIVERSITY OF NEW MEXICO.

During the past two years the University of New Mexico has been carrying on some work looking toward a scientific investigation of the climatology of the plateau, especially with respect to its beneficial effects in cases of tuberculosis and analogous diseases. Statistical information has been collecting, and special studies in the variation in vital capacity among students in the University and the public schools of the Territory have been carried on. The biological and bacteriological departments, under the special direction of President Herrick and Professor Weinzirl, have taken up the study of air and water and the conditions of sepsis, etc. It has been hoped to extend this investigation to include the physical and chemical characteristics of the climate and also a study of the blood changes due to altitude, with special reference to the virulence and curtailment of the diseases in question.

A few weeks since Mrs. Walter C. Hadley made to the University a proposition to donate to the institution the sum of $10,000, to be used toward the erection of a building to contain the laboratories for this and allied research. This gift was conditioned upon the raising of $5,000 for the completion of the building and a similar sum for equipment. The Regents have agreed to establish the chair necessary to continue and prosecute the research, and are making an earnest effort to secure the subscription of the amount requisite to secure Mrs. Hadley's donation. The location of the University is probably unsurpassed for such research, and the faculty already contains a corps of bacteriologists and biologists acquainted with the lines of work to be opened, several of whom have personal familiarity with the beneficial results of the climate.

One interesting result of the studies so far made is the evidence that a residence on the plateau during the growing years of later childhood serves in a large measure to correct the

narrow chests and limited vital capacity resulting from a bad heredity. It is hoped that a considerable response in the way of subscriptions will come from those interested outside the Territory, as the recent financial stringency has left those who would gladly respond incapacitated to carry the entire burden. It is understood that subscriptions may be sent to Hon. F. W. Clancy, Mayor of the City of Albuquerque, or to C. L. Herrick, President of the University.

GENERAL.

WE are glad to learn that Washington University, St. Louis, has just received generous gifts enabling it to remove to its new site facing Forest Park. This site was purchased with a fund of $200,000, contributed by seventy-five different subscribers. Funds for a library, to cost $100,000, are in the hands of the directors by the bequest of the late Stephen Ridgley. The following additional buildings have now been given by members of the Board of Directors: (1) A hall of languages, costing $200,000, by Mr. Robert S. Brookings; (2) an engineering building, costing $150,000, by Mr. Samuel Cupples, and (3) a chemistry building, costing $100,000, by Mr. Adolphus Busch. Mr. Brookings has also offered $100,000 on condition that $500,000 be subscribed at once for an endowment. St. Louis is, in size, the fourth city of the United States, and the University is now ready to take its place among the leading institutions of America.

MR. PHILIP D. ARMOUR has given $750,000 to the Armour Institute of Chicago, which he had previously endowed with $1,500,000.

THE will of the late Alexander M. Proudfit, of New York City, gives $30,000 to Columbia University for two fellowships, one in letters and one for advanced studies in medicine. There are also numerous other bequests to public institutions, including $10,000 each to the Public Library and to the New York Free Circulating Library.

KNOX COLLEGE, at Galesburg, Ill., has collected a fund of $100,000, thus securing the additional gift of $25,000 made by Dr. D. K. Pearsons.

AT a recent annual meeting of the Patent Nut and Bolt Company (Limited), held at Birmingham, the sum of £5,000 was contributed to the fund which is being raised for the establishment of a University in the City of Birmingham.

PRESIDENT SETH LOW, of Columbia University, was the University Day Orator of the University of Pennsylvania at its annual celebration on Washington's Birthday.

THE Register of Lehigh University, South Bethlehem, Pa., for the year 1898–99 shows but few changes in the teaching force. Professor Langdon C. Stewardson has assumed the duties of the chair of mental and moral philosophy, and the new professorship of history and economics has been filled by the election of Mr. John L. Stewart, late lecturer in that department. The department of mechanical engineering has lost the services of Messrs. B. H. Jones and L. O. Danse as instructors, and their places are filled by Messrs. L. N. Sullivan and J. C. Peck. Messrs. John Boyt and F. O. Dufour have been promoted from the grade of assistant to that of instructor, and Mr. Joseph Barrell has been elected instructor in geology and lithology. Solid geometry has been added to the requirements for entrance to the Latin Scientific course and to that in Science and Letters; and it is announced that in 1900 and thereafter the requirements for entrance to the course in Science and Letters, or to any course in the School of Technology, will include Plane Trigonometry and Logarithms, through the solution of right and oblique triangles. The elective system has been extended to the Latin Scientific course, so that it now seems to be possible for a student in either of the literary courses to complete before graduation one-half or more of any one of the technical courses. Such a student might, therefore, complete in six years the general training of the literary course and the special training of a professional course, and would in the end be much better equipped for professional work than one who had taken the technical course alone. The principle of elective studies is introduced also into the technical courses. In the course of Civil Engineering the student may elect a large amount of work in Architecture, in addi-

tion to the designing and structural work of the regular course, and thus be fitted to take up on graduating the profession of an architect. In the courses of Mechanical and Electrical Engineering a large proportion of the work is identical, and students in either course may in addition elect a considerable amount of special work in the other course, under the advice of the Faculty, as a substitute for the same amount of work in his own course.

Efforts are being made to persuade President Taylor not to leave Vassar College for Brown University. With this end in view a meeting of the Alumni decided to try to collect the sum of $2,000,000 for the endowment of Vassar.

It is announced that Mrs. Julia J. Irving will retire from the presidency of Wellesley College in June of the present year.

Dr. Myron D. Green has been appointed lecturer on photographic chemistry in the University of Cincinnati. A yearly course has been established in the subject, including each week one lecture and one afternoon of laboratory or field work. Our universities are beginning to recognize the importance of thorough and exhaustive instruction in this special branch of chemistry.

At a meeting of the electors to the professorship of pathology of Cambridge University, held on February 11th, Mr. German Sims Woodhead, M.D., Edinburgh, was chosen to succeed the late Professor Kanthack. The London *Times* states that Professor Woodhead is the eldest son of Mr. Joseph Woodhead, formerly M.P. for Spen Valley, and was born at Huddersfield in 1855. He was educated at Huddersfield College and at the University of Edinburgh. He first became a teacher in anatomy and then pathology, and carried on original investigations in pathology in the Minto-house School of Medicine, the University of Edinburgh, the Edinburgh Royal Infirmary, and the laboratory of the Royal College of Physicians, Edinburgh. For upwards of eight years he has held the post of Director of the Laboratories of the Conjoint Board of the Royal College of Physicians and of the Royal College of Surgeons. He was Assistant Commissioner to the Royal Commission on Tuberculosis, and his report was published in 1895. He has published a treatise on practical pathology, and, in conjunction with Dr. Arthur W. Hare, has published 'Pathological Myrology.' He has also written on bacteria and their products. He has held the office of President of the Royal Medical Society.

The Balfour studentship of Cambridge University, of the annual value of £200, for original research in biology, especially animal morphology, has been awarded to J. Stanley Gardiner, M.A., Fellow of Gonville and Caius College, for three years from March, 1899. Grants from the Balfour Fund of £50 each have been made to J. S. Budgett, B.A., of Trinity College, in aid of his researches on the development of *Polypterus*, and to L. A. Borradaile, M.A., of Selwyn Hostel, in aid of the expenses of his proposed journey in company with Mr. Gardiner, the Balfour student.

An examination will be held at Merton College, on June 27th and following days, for the purpose of electing to three open natural science scholarships, of which one will be at Merton College, one at New College and one at Corpus Christi College. The scholarships are of the value of £80 per annum, and are open to all candidates, including, we believe, those who are not citizens of Great Britain, whose age on July 3, 1899, will not exceed 19 years. The subjects of examination will be: (1) chemistry, mechanics and physics, or (2) biology. An English essay, and a paper in algebra and elementary geometry, will also be set to all candidates. Candidates will have an opportunity of showing a knowledge of higher mathematics.

Dr. Domenico Saccardo has been appointed professor of botany in the University of Bologna; Dr. Fleurens, professor of technical chemistry in the Conservatoire des Arts et Métiers at Paris; Dr. Natanson, of Vienna, assistant professor of mathematics in the University of Cracow, and Dr. Moritz Hoernes, assistant professor of prehistorical archæology in the University at Vienna. Dr. Bing has qualified as docent in chemistry in the University at Bonn, and Dr. Emden as docent in physics and meteorology in the Technical Institute at Munich.